PAINTS AND
COATINGS
SKILL COUNCIL

Participant Handbook

Sector
Paints and Coatings

Sub-Sector
Application

Occupation
Decorative and Industrial Paint Application

Reference ID: **PCS/Q5007, Version 2.0**
NSQF Level 4

Shop Tinting Assistant

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

Shri Narendra Modi
Prime Minister of India

PAINTS AND COATINGS SKILL COUNCIL

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for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: 'Shop Tinting Assistant' QP No. 'PCS/Q5007 NSQF Level 4'

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'Valid up to' date mentioned above (whichever is earlier)

Authorised Signatory
(Paints and Coatings Skill Council)

Acknowledgements

About this book

This Participant Handbook is designed to train participants for the job 'Shop Tinting Assistant', a NSQF approved level 4 qualification covered by QP reference no. PCS/Q5007.

The individual at work prepares paint in the colour mixing or tinting machine as per paint-company's shade card, colour code or matching panel, undertakes retail-counter sale and service and manages inventory at the shop.

This QP consists of 5 NOS, each dealt under a separate unit as follows

1. PCS/N5008   Perform colour mixing and matching.

2. PCS /N5009   Undertake counter sales and manage inventory.

3. PCS/N9901   Coordinate with colleagues and/or Customers.

4. PCS/N9902   Maintain standards of product/service quality.

5. 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

1. Introduction

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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. Describe what is paint and how it is made
3. Name different kinds of paints, their manufacturing techniques and characteristics
4. Explain what a paint system is
5. Discuss the importance of understanding colour and colour standards
6. Gain in-depth knowledge about finish and types of finish
7. Describe your role and responsibilities as a Shop Tinting Assistant

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 orthe 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.
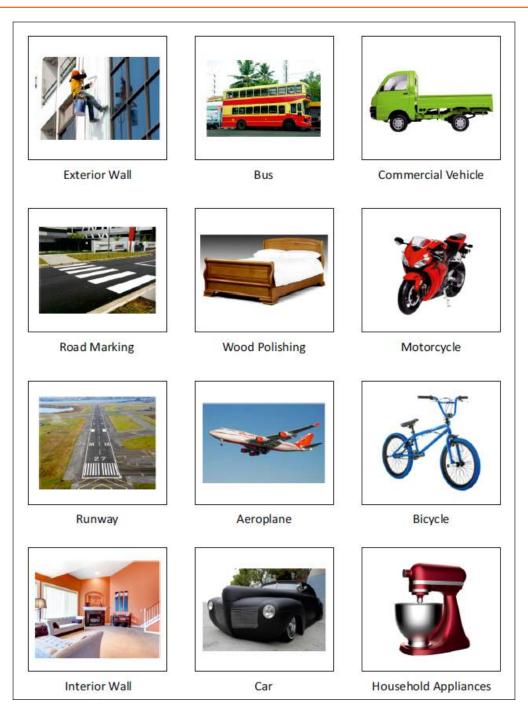
Fig 1.1: Paints are used everywhere

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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

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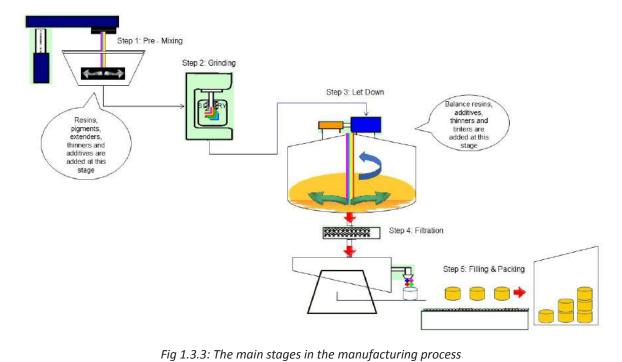
As we have already seen, resin is a major ingredient in paint and is responsible for making the paint into a film. There are different types of resins that can be used to make paint. It is important to understand the characteristics of each resin type as they determine the properties of the final paint.

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 Manufacture of Liquid Paints

There are five main stages in the manufacture of liquid paints as described below. A product may go through all or only some of these stages.

PRE-MIXING	GRINDING OR DISPERSION	THINNING/LET DOWN	FILTRATION	PACKING
This is the first stage. Measured quantities of raw materials are mixed using a high-speed stirrer. Agglomerates of pigments and other powder materials break down to give a uniform and homogeneous slurry	This is the most important stage in paint manufacture. Here the pre-mixed slurry passes through a mill that helps to break down the pigment agglomerates into primary particle size of the pigments. The output from this stage is finely ground pigment particles dispersed in the resin solution. It is referred to as the mill base.	The finely dispersed mill base is thinned down to the required viscosity. Adjustment for colour and other properties is also done at this stage. The quality of the paint is then tested for adherence to specifications	The paint is filtered to remove any foreign matter and/ or larger agglomerates before packing	This is the last stage where the product is packed, labelled as required for final sale

Fig 1.3.3: The main stages in the manufacturing process

1.3.4 Manufacture of Powder Coatings

The three principal steps in manufacture of powder coatings are illustrated and described as below.

Pre-mixing of raw materials → Extrusion of the premix → Milling of the chips

PRE-MIXING RAW MATERIALS	EXTRUSION OF THE PREMIX	MILLING OF CHIPS
Measured quantities of resins, pigments, extenders and additives are added into a premix vessel. The homogenous mixture of all raw materials is referred to as the premix. After requisite adjustments and quality checks, it is sent to the next stage.	This stage helps convert the premix into chips (also called flakes). The premix, is homogenised by passing it through an extruder. In the extruder, the premix is heated to melt the resins and the pigments, extenders, additives etc. are dispersed in the molten resin. The compounded molten mass is forced out of the extruder and cooled. It then solidifies to form a thin sheet which is broken into flakes or chips.	Milling or pulverisation refers to the chips being ground to a powdered form, i.e. the final product.

Note: For some powders, a fourth step is also required after milling, called post blending or tumble blending. This is required for metallic and effect finishes. The metallic or pearl pigments are added with the powder and after homogeneous mixing, the finished product is packed.

Fig 1.3.4 (i): Powder extruder
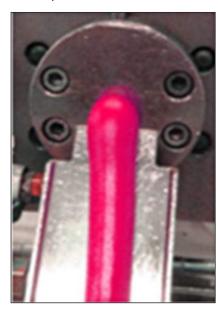
Fig 1.3.4 (ii): Powder extrudate

Fig 1.3.4 (iii): Chilled rollers *Fig 1.3.4 (iv): Flattening + cooling*

Fig 1.3.4 (v): Powder chips *Fig 1.3.4 (vi): Powder pulverisation*

1.3.5 Paint Systems

The beautiful smooth or textured finishes on the walls in buildings and the gleaming colours that we see on cars are painstakingly achieved by applying layer after layer of different paint systems. Additionally, bridges and building exteriors withstand years of damage caused by natural elements such as sunlight and rains because of careful and scientific application of several layers of anti-corrosive paints.

A paint system is essentially a (usually pre-specified) systematic multi-layer application of paint products to various substrates. Each layer in the system has a specific function. Different products are applied in a defined sequence to achieve best results for each substrate. The paint system and the products employed depend on the following:

1. Substrate
2. The service to which the final product is put, extent of wear and tear with exposure to natural elements that it will be subjected to
3. Handling

A surface to be coated is referred to as a substrate. The coating on the substrate must work towards its protection and overall visual appeal. Commonly coated substrates we encounter everyday are wood, plastic, metals and masonry.

A typical paint system is illustrated below.

Fig 1.3.5: A typical paint system for automotive coating

1.3.6 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. 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.

1.3.7 Comparison of Different Liquid Paint Systems

We have already seen different resins that are used in paint under section 1.3.2. As indicated there, each type of resin lends different characteristics to the paint where it is used. Paints also differ in terms of their curing pattern. Thus, a paint could be either one component (1K) or two component (2K). The two component paints are supplied as a base and hardener in separate packs.

DRYING/CURING	PAINT TYPES
AIR DRYING	• Enamel (IK) • Emulsion (IK) • Acrylic (1K) • Polyurethane (2K) • Epoxy (2K) • Chlorinated rubber (1K) • Bituminous Paint
STOVING	• Stoving Enamel • Thermosetting Acrylic • Epoxy Esters • Blocked Isocyanate • Polyesters • Powder Coating
MOISTURE CURED	• Polyurethane (IK) • Epoxy (IK)

1.3.8 Comparison of Different Powder Systems

The advantages and disadvantages of different types of powders are enumerated in the table below.

POWDER SYSTEM	ADVANTAGES	LIMITATION
EPOXY	• Good chemical resistance • Best corrosion resistance • Better surface hardness • Better mechanical properties	• Poor UV resistance • Sensitivity to colour variations when exposed to heat or sunlight
EPOXY POLYESTER	• Good flow • Good application properties • Low colour variation • Flexibility in formulation	• Slightly better UV resistance than epoxy.
POLYESTER	• Good outdoor durability • Good mechanical properties • Good colour stability	• Lower chemical and solvent resistance than epoxy.

POLYURETHANE	• Good mechanical properties • Good chemical resistance • Better outdoor durability • Good flow and smoothness	• High cost • Emission of blocking agent during curing
ACRYLIC	• Best flow and clarity • Good chemical properties • Best hardness • Better outdoor durability • Best for clear powders	• Severe incompatibility with other powders • Storage stability • Poor pigment wetting • Expensive

Fig 1.3.8 (i): Pure Epoxy (PE) usage on coated pipes and valves

Fig 1.3.8 (ii): Pure Polyester (PP) usage on wheel rims and stand of a car's rear view mirror

Fig 1.3.8 (iii): Epoxy Polyester (EP-Hybrid) used on lockers and shock – absorbers

Fig 1.3.8 (iv): Polyurethane (PU) or Acrylic (Ac) applied on industrial parts

1.3.9 A World of Many Products and Opportunities

It would thus be seen that both in the case of liquid paints and in the case of powders there is a wide variety of products to choose from. Paint professionals needs to be aware of the different types of products and their properties. They should also be able to explain the advantages and disadvantages of different types of products. Further, the correct product as specified by the customer or in the technical specifications must be used.

You will thus notice that paint is a fascinating product. Just think of this one example: today a motor car made almost entirely of steel, a metal that corrodes easily and rapidly when exposed to normal weather, can, when correctly painted with good quality paint available in India, take the highly corrosive outdoor environment of coastal cities such as Mumbai or Kochi with hot summers and wet monsoons and not show any sign of corrosion even after ten years.

Several job opportunities exist in the making, packing, distribution and sale of paints, broadly referred to as the manufacturing sub-sector of the industry. You can acquire skills required by paint factories – for example in processing, colour matching, filling and packing or quality control; or in sales outlets, mixing and tinting colours to customer specifications.

However, the bigger part of the paint sector is the application sub-sector. It offers a much larger scope for employment - in the application of paints: be it architectural paints, wood finishes or industrial paints.

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UNIT 1.4   Colour

Unit Objectives 🎯

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

1.   Explain 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 and changes as the light source is changed. When we speak of colour, we normally refer to what is seen in day light.

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
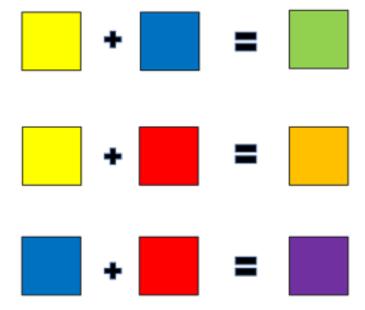
Fig 1.4.1 (iii): Mixing of colours

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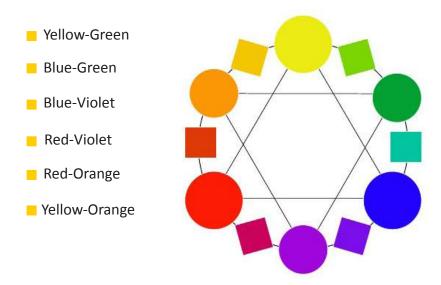
Fig 1.4.1 (iv): Intermediary colours (pinsdaddy.com)

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)

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.
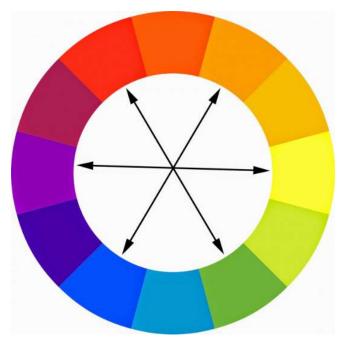
Fig 1.4.1 (vi): Complimentary colours (copicmarkertutorials.com)

	Warm Colours	**Cool Colours**
HUES	Reds	Blues
	Yellows	Blue-greens
	Oranges	Blue-violets
	Red 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)

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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
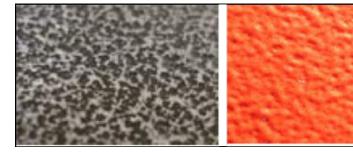
Fig 1.6 (ii): Hammer tone finish, structure finish and coarse texture
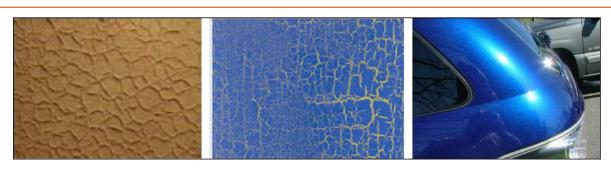
Fig 1.6 (iii): Wrinkle, antique and metallic finish

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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
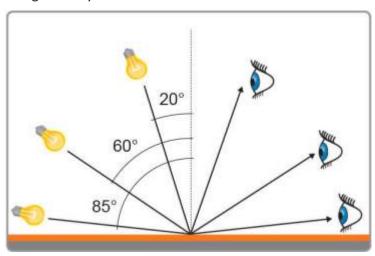
Fig 1.7: Reading gloss at different angles

Fig 1.8: Digital Glossmeter

UNIT 1.8 Job Role of a Shop Tinting Assistant

Unit Objectives ◎

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

1.   Clearly state different aspects of your job
2.   Explain the scope and career opportunities for Shop Tinting Assistants

A Shop Tinting Assistant is a person who works in a paint dealer's shop, preparing colour as required by the customer, for various products, using tinting machines.

This is a skilled job that requires specialised training. The value or benefit realised by a customer in terms of various product and colour options can be enhanced by a properly trained tinting assistant by suggesting products and colours meeting the customer's technical and commercial requirement. A trained tinting assistant could, not only find employment opportunities at a paint dealer's shop but also at paint company sales depots and factories, for preparing various shades by mixing different colourants, bases and other ingredients to fulfil the customer's requirement.

Over the last few years, the demand for direct colours, especially for decorative painting, has increased sizeably. Gone are the days when painters would prepare a shade at the site by mixing universal stainers in different products to achieve the colour of customer's choice. Majority of the customers prefer direct colour, chosen from either the brand shade card or fandeck. Therefore, mixing the required colour at the sales point has become important.

The introduction of tinting machines has helped the paint dealer reduce the stock he has to hold of the various products. At the same time, it enables him to cater to any colour requirement of the customer. Instead of stocking various colours while running the risk of a stock out some colours, the paint dealer now needs to stock only bases and universal colourants or tinters. The bases and colourants greatly increase the capability of supplying any colour required by the customer.

In the initial days, buying a tinting machine from even one paint supplier required careful thought a huge investment for a paint dealer. But today, due to consistent and increased demand for direct colours from customers, dealers are investing in tinting machines from more than one paint supplier.

As a result, the role of a shop tinting assistant has become critical and important. This has led to good career growth opportunities for well-trained tinting assistants.

The Shop Tinting Assistant is a person familiar with the use of colourants and paint bases to produce different colours, displayed on a shade card/fandeck. He is trained to operate the tinting machine using its controls and to load and unload production materials with all safety devices enabled. He or she must understand the operation of the machine thoroughly and be able to work in a safe and efficient manner.

A shop Tinting Asistant's primary role is to handle the tinting system at the dealer's shop for preparing colours, for the different products. Additionally, he should also take care of stock management, basic maintenance of the tinting machine, safety, cleanliness and hygiene of the working environment and interaction with customers.

With due experience a person in this job may progress to other roles as indicated below:

Shop Sales Assistant: At this stage, he would have not only mastered the operation of the tinting system, but would be also interacting with customers, guiding them in the use of the right product,

within their budget, coordinating with painters and painting contractors, passing on trade enquiries, handling the responsibility of maintaining inventory, purchases and stock management to minimise losses and piling up of wrong inventory. This would mean higher rewards and responsibility.

Shop Manager: As a Shop Manager, all the other staff of the shop like tinting assistant, shop boys, shop sales assistant and sometimes even basic accounts staff report to him. The job at this level involves better coordination with the painters and painting contractors, follow up on outstanding payments and coordination with supplier personnel. This would not only mean higher rewards butcarry higher responsibility and accountability.

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Scan the QR code for video

2. Perform Colour Mixing and Matching

PAINTS AND
COATINGS
SKILL COUNCIL

Unit 2.1 - Setting Parameters on the Tinting Machine

Unit 2.2 - Shades, Shade Cards and Fan Deck for Paints

Unit 2.3 - Using the Decorative Tinting Machine

Unit 2.4 - Adding Colourants to The Cannister

Unit 2.5 - Making Shade Panels

Unit 2.6 - General / Preventive Maintenance

Scan the QR code for video

Applicable NOS – PCS/N5008

Key Learning Outcomes

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

1. Classify the tinting machines as automatic and manual
2. Operate the tinting machine
3. Develop colours as required by customers
4. Plan preventive maintenance and troubleshooting of the tinting machine

UNIT 2.1 Tinting Machines, Types, Features and their Components

Unit Objectives

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

1. Distinguish between an automatic and manual tinting machine
2. Explain different components and features of the tinting machine

2.1.1 What is a Tinting Machine?

Whites, dark colours and pastel colours are generally used for painting interior or exteriors of homes for decorative purpose. Though, the volume of whites is still the highest, the volume of colours is growing at a fast rate.

All the major paint manufacturers offer more than 1,500 colours depending on the type of product. As discussed above, to offer this wide colour choice to the customer, the paint dealer will require to keepstock of all the shades, in all the product categories, and of different manufacturers.

This is an impossible task for any paint dealer! The solution – colour matching at the point of sales using tinting system.

Paint manufacturers supply different bases for making various colours, in different products and different pack sizes. Addition of the colourants, as per the formula, converts the base into the customer's colour choice. This process of mixing base with colourants is called 'Tinting'. There are different types of machines to do tinting and they are called 'Tinting Machines'. Typically, the machine is used in conjunction with other accessories such as a computer, gyroshaker, colour formulations, colour cards etc. This entire package which helps in making a can of paint of the desired colour is referred to as a 'Tinting System'.

A Colourant is essentially concentrated colour in a liquid form. Combinations of different colourants and bases and yield a very wide variety of shades. Since the colourant has a high concentration of pigments, it tends to settle. This means the portions at the bottom of the container will be more concentrated than at the top. It is therefore essential to keep stirring and mixing the colourant from time to time. Otherwise the shade made by using the colourant will not be consistent and will not match the standard.

2.1.2 Types of Tinting Systems

Tinting systems can be broadly classified into two types.

1. Tinting systems for decorative paints and wood finishes
2. Tinting systems for automotive paints

In tinting systems for decorative paints and wood finishes, the following two types of dispensing machines are used.

- Manual

- Automatic

Automatic Colour Dispensing Machine: This is the central component of the tinting system. All the commands given through the computer are executed by this machine. This automatic colour dispensing machine has following 4 parts:

- **Cannister:** For storing colourants, which are required for preparing the colours, offered by the paint manufacturers.

- **Nozzles:** These are the outlets for the colourants to be dispensed in the required quantity in the cans/drums of bases; there will be one nozzle per cannister.

- **Drum rest:** The tin/ drum of the base is placed here for preparing the colour.

- **Tin stand:** For colour matching of small packs (500 ml. etc)

Fig 2.1.3 (i): Various models of automatic tinting machines

Fig 2.1.3 (Ii): Various models of automatic tinting machines

MANUAL	AUTOMATIC
This machine is known as Manual Colour Dispenser (MCD)	This machine is known as Automatic Colour Dispenser (ACD)
Electricity is required only for running the stirrers in the colourant cannisters	These dispensers are fully automatic and need uninterrupted electrical power supply for the full system
The colourant dispensing operation is manual and does not require electricity	The colourant dispenser operation is automatic and controlled by a computer linked to it
As the colourant addition is manual, each stage of addition must be done carefully	The colourant selection is based on the colour matching formula in the system. The colourant dispensing is automatic
The accuracy of the colour match is completely dependent on the operator's skill and knowledge.As a result, the chances of errors/mistakes are higher	The accuracy of colour matching is very good, and the chances of errors/mistakes are low
A skilled tinting assistant can achieve a good colour match, resulting in greater accuracy and minimal losses due to mistakes in colour matching	The colour matched achieved is consistent and accurate

2.1.3 Components of a Tinting System-Overview

DECORATIVE AND WOOD FINISHES		AUTOMOTIVE PAINTS	
Automatic (ACD)	Manual (MCD)	Semi-automatic	
UPS (Uninterrupted Power Supply)	Power supply only for colourant mixing in cannister	Stirring and storing racks-pneumatic stirring	
Computer set with suitable software	Shade formulae booklet / computer set	Formulae tables or shade tabs with formulae	
Automatic colourant dispensing	Manual colourant dispensing	Manual colourant addition with help of an electronic weighing scale	
Gyroshaker	Gyroshaker	Gyroshaker	

2.1.4 Components of Automatic Tinting System

UPS: It is a unit which gives power to the tinting dispenser, computer and printer. The power supply to these is given through UPS to ensure uninterrupted power supply, even in case of electricity failure/power cut. This will ensure dispensing of colourant from the tinting machine is not halted, resulting in wastage of base and colourant material.

Computer: This is the 'Brain' of the tinting system, as the dispensing of colourants, as per the formula, is controlled through the computer.

The product/s, colour/s and pack size required by the customer, is selected from the data base stored in the computer. On clicking the command to tint the colour, the colourant dispenser dispenses the specified quantity of colourants to prepare the required colour.

The computer also indicates the balance quantity of colourant remaining in each cannister and prompts for refilling the same.

Lighter and darker hues of the colour indicated in the shade card, can be made, if required by the customer by adjusting one or more colourant quantity and observing the colour on the computer screen. A small sample can also be prepared and applied to demonstrate the actual colour to the customer.

Some colour matching software also offer the option of calculating the cost of the colour, provided the cost of the colourants and base are available in the data base.

The computer can also notify any malfunctioning of the tinting system and suggest corrective actions. It can suggest routine maintenance tasks, which has been discussed in (understanding the operations of the tinting system).

Like any other computer system, it has the following four components:

- CPU
- Monitor
- Keyboard
- Mouse

It is very important to maintain this machine in good working condition with regular preventive maintenance, to minimise tinting errors/losses. This is covered in detail under "preventive maintenance" below.

Gyroshaker: After addition of the colourant/s to the base, the paint needs to be mixed thoroughly to achieve a homogeneous colour. This is done by a gyroshaker, which is nothing but a mixer which either rotates or shakes the drum/tin at a very high speed. The duration of the mixing is selected by a mechanical/electrical timer on the gyroshaker. This operation of the gyroshaker requires normal electric power. In case of a power failure, UPS power cannot run this machine. This machine has the following five parts.

1. Timer knob
2. Guide rod
3. Handle assembly
4. Top disc
5. Bottom disc

Fig 2.1.3 (iii): Various models of gyroshakers

Printer: This is used to print labels for the tinted drums/tins, which carry information like colour name, colour code etc. It is attached to the computer. The tinting programs offered by paint manufacturers, have the option of printing labels after tinting a colour.

2.1.5 Manual Colour Dispensing System

Manual Colour Dispensing Machine: This is the only important component of MCD system. The quantity of the colourant to be added is manually selected with the help of the scale on each cannister.

This machine has following 6 parts.

1. **Scale (Two):** This isto select the required quantity of colourant to be added to prepare the desired colour. There are two scales on each cannister - one with a least count of 1 millilitre and the other with a least count of 0.1 millilitre.

2. **Cannister:** It is a container for storing the colourants, from which the colourant is manually dispensed into the base.

3. **Colourant pump:** The pump is used to add the colourant into the base drum/can.

4. **Brake/stopper:** This is to restrict the movement of the turntable during colourant dispensing.

5. **Nozzle assembly:** This is where the colourants are actually dispensed from.

6. **Timer:** The timer monitors the stirring of the colourants in the cannister by starting the stirring process after an interval of 30 seconds each for every cannister.

Fig 2.1.4: Manual Colour Dispensing Machine

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UNIT 2.2   Shades, Shade Cards and Fan Deck for Paints

Unit Objectives

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

1.   Select the colour from the shade card or fan deck for decorative paints and shade tabs and swatches for automotive paints
2.   Distinguish between bases and colourants

As seen in the section on colours, various colours are achieved by mixing primary, secondary, tertiary colours. Similarly, different colours of decorative paints are achieved by adding different colourant/s to the bases.

All colours are displayed on a shade card meant for a product or on a "Fan Deck" which displays all the colours that a paint manufacturer offers, in all its products. Each colour has a unique colour code and/or colour name.

As the colour card opens like a fan displaying all the colours, it is called a "Fan Deck". The product colour card or Fan Deck is used to display 'Standard' or 'Guide' colours for customer selection and also for matching it to the colour achieved after tinting.

Fig 2.2 (i): Fan deck (dorncolor.com)

Fig 2.2 (ii): Shade card (vakaba.com)

2.2.1 Understanding Products Like Bases and Colourants for Decorative Paints

For both interior and exterior products, the colours are prepared by mixing colourant/s with the base. Generally, each product, has 4 to 6 bases, which can be used to prepare almost 90% of the colours indicated in the shade card or Fandeck.

For darker colours, coloured bases like yellow, red etc. are used to:

* To keep the consumption of colourants low

* Achieve proper opacity and coverage

* Lower the cost

For manual tinting, the shop tinting assistant should study and understand this thoroughly for mastering the job. In the automatic dispensing machines, this process is guided by a computer programme offered by the paint manufacturer.

2.2.2 Shade Tabs, Shade Swatches for Automotive Paints

In automotive paints, the desired colour is prepared by mixing base, clear and colourant/tinter. A collection of shade tabs or shade swatches available from paint companies, showing different colours offered is available. The formulae for these colours is also mentioned/printed on the back of each shade tab. The tinting person mixes the base, clear and colourant/s in the proportion (weight) mentioned on the back of the shade tab with the help of an electronic weighing scale.

Fig 2.2.2: Automotive colours

The shade tabs are used as a 'Standard' or 'Guide' for both colour selection by the customer and for colour matching after tinting. A tinting assistant must understand the collection of shade tabs offered by different paint manufacturers for tinting colours.

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UNIT 2.3   Using the Decorative Tinting Machine

Unit Objectives ◎

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

1. Operate the automatic tinting machine, step by step as recommended by the manufacturer
2. Operate the manual tinting machine, step by step as recommended by the manufacturer
3. Operate the tinting system for automotive colours

2.3.1 Important Daily Checklist

Every day, before starting the tinting operation the following checklist should be followed:

- Check all the connecting cables

- Switch on the computer

- Check communication between the tinting machine and the computer, making certain mandatory initialisation processes etc.

- The above are mandatory daily activities, without which the tinting operation should not start.

- The chapters ahead in this participant handbook will discuss the above in detail, when we look at the actual colour matching process at the dealer shop.

- Given below is a brief description of colour matching (also called as tinting) and the different tinting systems.

2.3.2 Step-by-Step Operation and Colour Matching

Operating the machine involves various steps, covered in detail in the sections below. There would be small differences in the steps depending on the make/ brand of the tinting system, but these can be easily learnt and mastered by the tinting assistant once the overall process is well understood.

Switching on and switching off the machine

A tinting machine once switched on in the morning, should be turned off only at the time of closing the shop/operations, as the stirrers fitted in the colourant cannisters keep moving at fixed interval to keep all the colourants in consistent, homogeneous condition, fit for mixing in paints. This also prevents colourants from becoming dry/stiff and prevents lump formation in them.

The computer attached to the machine can be switched on every morning for use and switched off every night at the time of closing the shop.
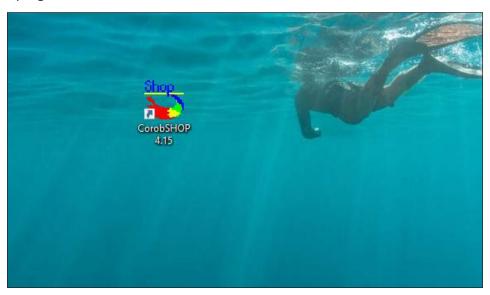
After switching on the computer, one needs to do some routine checks before starting the operations or tinting products. They are as follows.

- Check all the electrical connections to ensure there is no malfunction due to improper connection of cables, electrical points etc.

- Check colourant levels both in the cannisters and in the system on the computer screen. If required, top upcolourants taking care to add each colourant in its correct cannister. Please note that when you add physical quantity of a colourant, you need to go the computer programme and use option of 'Add Colourant' to update the added quantity, manually. Remember, there is no system in the machine, which would understand and update the added, physical quantity of colourant, automatically. The stock shown in the tinting programme/software must be updated manually, after adding each colourant, as mentioned earlier.
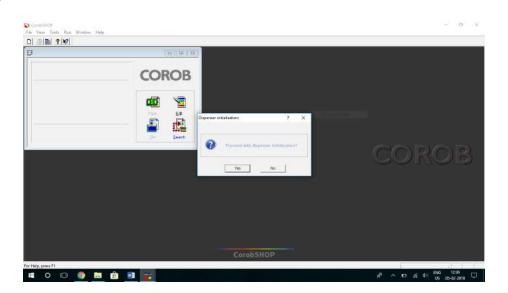
Steps to make shades in the Automatic Tinting Machine

After switching on the tinting system and computer and completing initializing process, the machine is ready for making shades as per customers' requirements. Once you receive an order for making a shade of a product, following are the steps to complete the process

Initialising in progress

Click 'Yes'
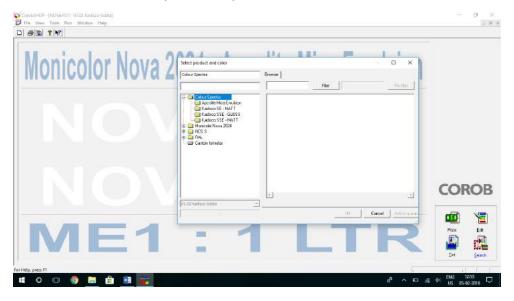
Purge Test - Click 'No'.

Click 'Search' button.
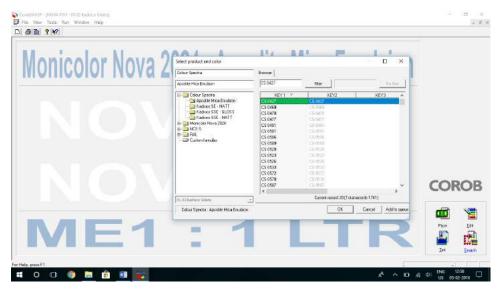
Select a shade card. This will show you all the products.

Select a product. This will show you all the available shades for the selected product.
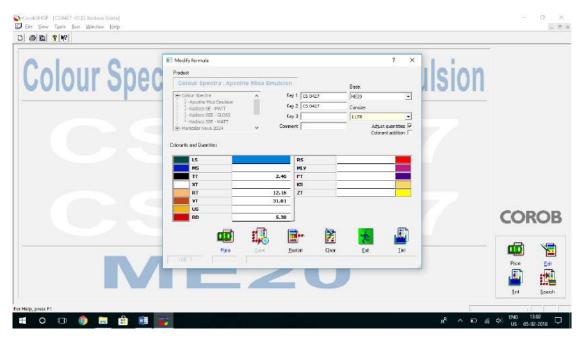
Select a shade. By typing the number in the box before 'Filter' button or by searching down.
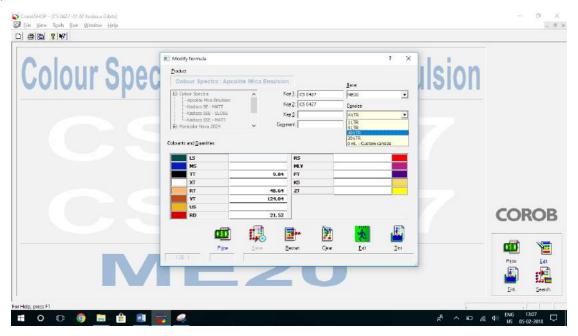
Click 'OK' to select the shade. At this stage, the programme will tell you the required base for the shade.
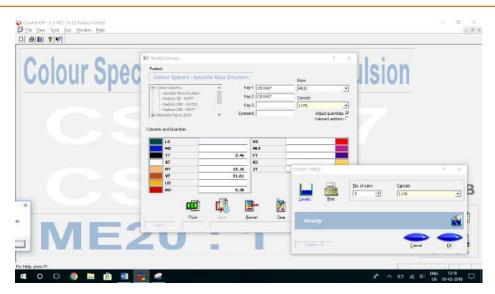
Clickedit to select the tin size.
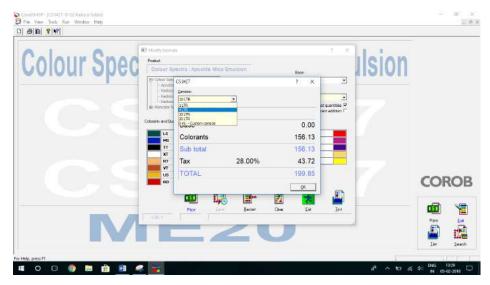
Select the appropriate can; custom can size option is also available. See the last option in 'Cansize' dropdown.
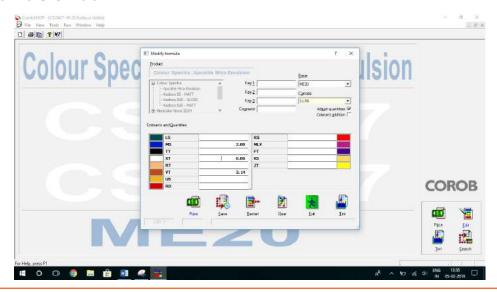
- After selection of the can size, the programme will show the formula for the shade. At this stage, open the base can and keep it below the nozzles for dispensing the colourants and click 'Tint' button.

- At this stage, select the number of tins that are to be tinted. This is useful when multiple tins are to be tinted.

- After the machine finishes dispensing for one tin, it will show the same screen again (see below), place the next open tin of the base under the nozzles and click 'OK'.
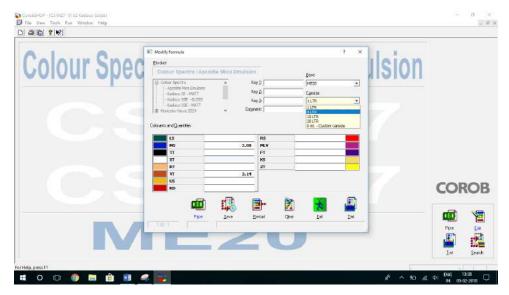
By clicking the 'Price' button, the price for the selected product and shade will be displayed before tinting. This is helpful when customer wants to know the cost of the product and shade.
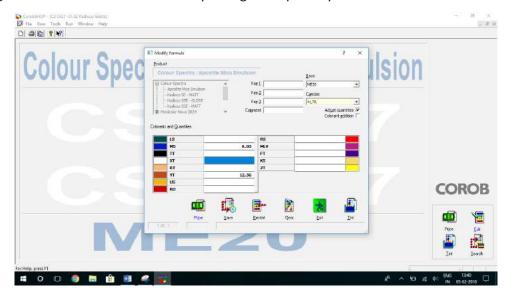
Special shades can also be tinted with the formula acquired from the manufacturer. This can be done by clicking 'Clear' button. This will blank all the colourant values. Select and enter values of colourant mentioned in the formula.
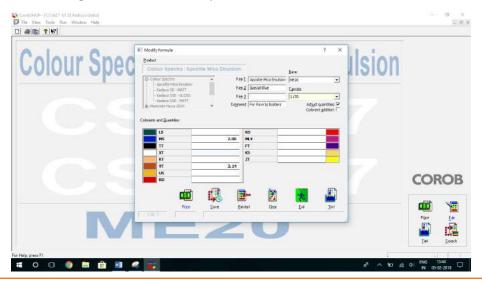
Remember to always enter the formula for one litre and then change the can size as required.

Changing the can size would automatically change the quantity of the base and colourant to be used.

Save the special formula by putting in detail in the blank 'Key' boxes and 'Comment' box. This would be helpful in maintaining the records of the special shades and future use.

UNIT 2.4 Adding Colourants to The Cannister

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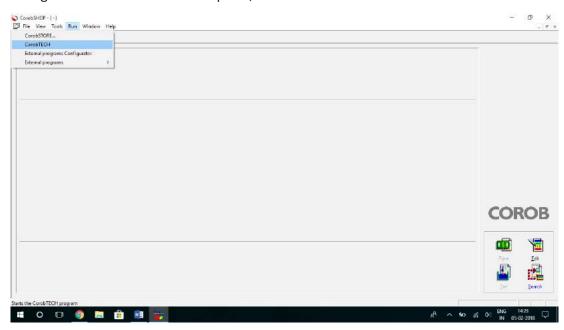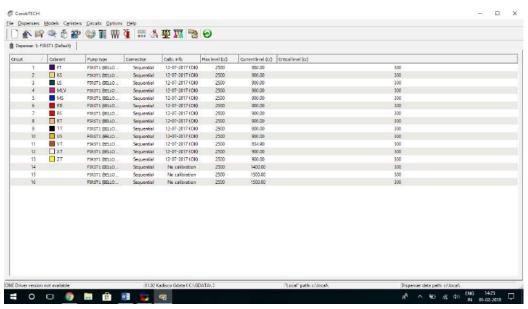
At the end of this unit, you will be able to:

1. Select the correct procedure for updation of colourant level in Automatic Tinting Machine
2. Make proper use of the gyroshaker for mixing the paint
3. Apply the procedure for colour matching using Manual Tinting Machine
4. Demonstrate the use of tinting systems for automotive paints
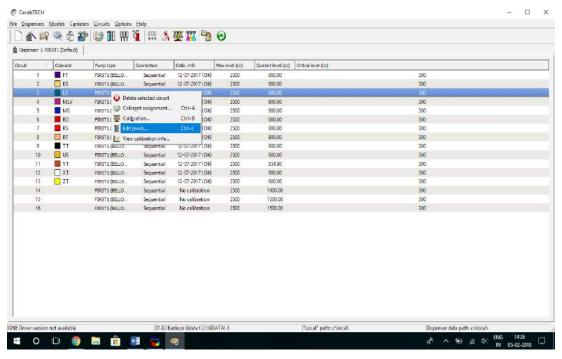
By selecting 'CorobTECH' under 'Run' option, colourants can be added.
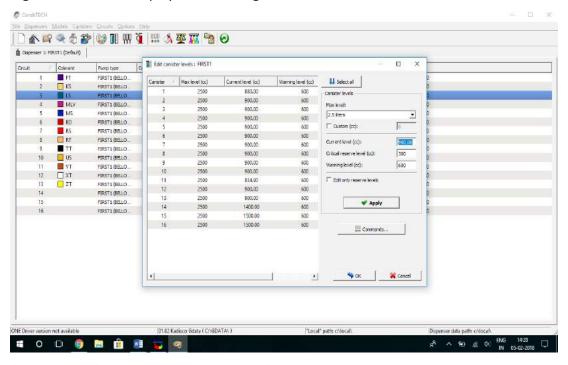
The following screen will be displayed.

Right click the colourant cannister which requires to be refilled, it will display the following screen.

Selecting 'Edit levels' will display the following screen.

Go to 'Current level' and update the quantity of colourant added to the cannister in ml.

If one litre has been added, then add 1000 in the box and click 'Apply' and 'OK' buttons. This will update the quantity of that colourant in the system. This sequence must be followed for adding multiple colourants, one by one.

1. After all the required colourants have been dispensed, close the can properly. Now the can is ready for mixing in the gyroshaker.

2. Open the cover of the gyroshaker and place the can on the lower plate.

Fig 2.4 (i): Gyroshaker

Fig 2.4 (ii): Placing the tin on the lower plate

3. Push the upper plate on the can to the maximum, lock the can by using the keys provided on the two guide rods, in such a manner that the can is locked properly between the two plates. As the gyroshaker moves the can in circular direction at a very high speed, this ensures that the tin doesn't move or slip out of the two plates, while shaking/mixing.

Fig 2.4 (iii): Securing the gyroshaker

Fig 2.4 (iv): Securing the gyroshaker

Fig 2.4 (v): Securing the gyroshaker
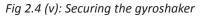
Fig 2.4 (vi): Closing the gyroshaker

4. Close the cover of the gyroshaker and set the timer to 4 or 5 minutes. The gyroshaker would start rotating the tin. In case of distemper it is advisable to shade the tin/drum before tinting and give additional time than normal, after tinting.

    Once the set time is over, wait for the tin to stop rotating completely and then open the gyroshaker cover. At this stage, follow the steps mentioned above in reverse order to remove the drum/tin from the gyroshaker.

5. Open the tin again to check and confirm the shade with the customer. Close the tin again and deliver to the customer.

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UNIT 2.5 Making Shades Using Manual and Semi-Automatic Tinting Machines

Unit Objectives

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

1. Operate a manual tinting machine
2. Make shades on a manual machine using formulae provided by the paint supplier
3. Match automotive repair paint colours using a semi-automatic mixing rack

After switching on the tinting system (for stirring of colourants in the cannisters) and computer (if provided) and completing initialising process, the machine is ready for use and making shades as per customer requirements. Once you receive an order for making a shade of a product, the following are the steps to complete the process.

- Open the product and the shade in the computer or in the shade formulae booklet and check the number of colourants and quantity of each one of them required for making the shade. This will also guide you to select the correct paint base required for making the shade. (if the computer is provided with the machine, then you can follow steps 1 to 4 mentioned above in the Automatic Colour Dispenser process to arrive at the right paint base and shade formula for tinting)

- Open the tin/drum and place it on the plate provided for the purpose.

- Rotate the cannister turntable to bring the desired colourant cannister above the open base tin.

Fig 2.4 (vi): Dispensing from a manual system

Fig 2.4 (vii): Cannisters on a carousel in a manual dispensing machine

Fig 2.4 (viii): Locking the system

Lock the turntable by applying brake/stopper to prevent it from moving/rotating while dispensing the colourant.

- Adjust both, ml and 0.1 ml scales to desired level as per the formula of the shade mentioned in the booklet, to dispense the colourant into the base.

Fig 2.4 (viii): Scales   Fig 2.4 (ix):0.1 Millilitre scale   Fig 2.4 (x): 1 Millilitre scale

- Dispense the colourants by pushing the colourant pump all the way to the bottom, wait for the required colourant quantity to get dispensed in the can completely (to the last drop).

- If, more than one colourant is required for making a shade, release the brake to rotate the turntable to position the next desired colourant cannister above the open base tin and repeat steps 4,5 and 6 above.

After you complete dispensing all the colourants required for the shade, close the tin.

Follow steps 1 to 5 mentioned above in the Automatic Machine tinting process for using the gyroshaker and mixing the base and colourant to get the desired shade.

Fig 2.4 (xi): Locking the machine

Tinting systems for automotive paints

- These are generally semi-automatic tinting systems
- The tinting system is basically a rack fitted with mechanical stirrers, in which the base, colourant and clear cans can be mixed to maintain homogeneity during storage

Fig 2.4 (xii): Automotive refinish mixing rack (tradeindia.com)

- The desired colour is achieved by mixing the recommended base, clear and colourants from the cans stored in the rack. The additions are done manually, by measuring on an electronic weighing balance, as per the colour formulae provided by the manufacturer

- The basic difference between decorative/wood finishes tinting system and automotive tinting system is that, in decorative/wood finishes the desired colour is prepared by volumetric mixing of base and colourants, using either a manual or automatic dispenser and in automotive, the desired colour is prepared by manually mixing base, clear and colourants, by weight

- The steps are as follows:

  ♦ Switch on the rack at the time of opening the shop. This is will start stirring all the cans that are stored in the racks. Once the proper mixing is completed, the process will automatically stop, then the cans are ready to be mixed with each other, as per formulae, to make different shades. The machine should be kept 'on' throughout the day as the stirring goes on intermittently, at a fixed time interval. This ensures that the cans are ready for mixing anytime of the day. Switch off the racks only at the time of closing the shop.

  ♦ The formulae are mentioned in shade formula booklet or stored in the computers or are mentioned on the back of the shade swatches.

  ♦ Pick up the can of the base, colourants and clear, mentioned in the formula, from the rack after putting an empty tin on the electronic weighing scale. Please remember here that all the shades are made by mixing different base, colourants and clear, by weight in grams for making one litre of final shade. This is the reason why an electronic weighing scale is required for making automotive shades as it provides for precise addition by weight.

  ♦ Add the different bases, colourants and clear mentioned in the formula by weight in the empty tin, to make the desired shade. The tinting rack system provides for special can caps with nozzles, which allows dispensing small quantities required for making a shade, as per formula.

  ♦ Finally, after adding all the bases, colourants and clear, mix the same in gyroshaker or by a stirrer. Apply the product on a small panel, dry and compare to the standard or desired colour before handing over to the customer.

- Many times, only a small quantity of the final shade, often less than a litre, may be needed by the customer for carrying out a touch up or repair job on the vehicle. In such cases, breakdown or scale down the formula for the quantity required, as all the formulae are provided for one litre. For example, if the requirement is for 250 ml of paint, then take only 25% quantity of each item mentioned in the formula, to make 250 ml of final shade. A calculator in good working condition is recommended for doing such calculations to avoid calculation errors.

- Another unique aspect of automotive shade making is that many a times a shade made as per the standard formula, may not match with the desired shade. This is because the actual shade on a vehicle to be touched up may have slightly deviated from the standard due to a variety of reasons. In such cases, corrections are made by adding small quantities of required bases/ colourants/ clear. A few iterations may be required, of making additions and checking the panel before the correct match is obtained. This calls for some judgement and can be learnt through systematic practice and experience.

UNIT 2.6 Colour Matching

Unit Objectives

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

1. Prepare shade panels the correct way
2. Make up the colour as required by the customer

2.6.1 Making Shade Panels

A Shop Tinting Assistant should learn to make colour panels and drawdowns of the prepared colour for colour matching against the shade card/Fandeck. In case of new colours, these can be preserved as a record/new standard for future reference. The process of preparation of panels/ drawdowns is very simple. The prepared colour is applied with a brush/ roller on a Back and White card paper (coated paper). The Black and White paper is used to ensure that proper opacity is achieved. A 100 μ or 150 μ drawdown gauge is used for preparing the drawdowns.

In the case of automotive and industrial paints the panel must be applied with a spray gun to ensure an accurate match.

While applying a panel by brush, roller or spray, ensure that the film thickness is adequate as applying too thin a coat can give a misleading shade.

2.6.2 Checking the Match

After completion of the tinting process, open the tin and check the colour against the standard colour in the shade card or Fandeck. This can be done by application of the prepared colour on a white card paper, drying it under a lamp and comparing the colour against the standard. If the colour does not match to the standard, the reasons could be:

(a) Use of wrong base other than the recommended

(b) All colourants required for preparing the colour did not get dispensed. This could be due to
  - Insufficient colourant in the cannister
  - Choked nozzles
  - Insufficient mixing of the tin in the gyroshaker

The colour can be corrected in the above cases, by correcting the causes mentioned.

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UNIT 2.7 General / Preventive Maintenance

Unit Objectives ◎

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

1. Plan preventive maintenance of the tinting system and gyroshaker
2. Solve day to day problems of the tinting system

Regular use of any machine causes wear and tear and the tinting machine is no different. Periodic preventive maintenance is necessary to avoid break down of the machine. It ensures that the machine is in good working condition, there is no down time and business loss due to machine breakdown is minimised. Preventive maintenance increases the life of the machine.

2.7.1 General/Preventive Maintenance of Automatic Tinting Machine

The most important activity is to ensure right connection sequence, starting from electrical plug to the printer, is maintained. The maintenance activities mentioned below should be followed as per the frequency mentioned/ or as recommended by the supplier.

DAILY	WEEKLY
Humidifier cup maintenance for dispenser: make sure that the sponge is moist and enough water retention to last for the day. In hot conditions, this can be checked every 4-5 hours. Add water, if required. This prevents the nozzles from drying up or leaving dry colourant on the nozzles, thus ensuring that the flow path of the colourants is clear, and the required quantity is dispensed without any obstacle.	Nozzle purge test for all colourant level verification with the software.

This also can be done with the option available in the tinting programme. |
| Dispenser initialisation is done automatically by the tinting programme. It only needs to be monitored to ensure that it happens when the tinting system is switched on at the start of the day. | |
| Clean all the nozzles carefully with a damp cloth. The type of cleaning product to be used depends on the type of colourants used in the machine. Remove any dried colourant residue from nozzle with a sharp tool. Perform this operation delicately to avoid damaging the ends of the dispensing circuits that may make up the nozzle centre. | |

Pour water into the nozzle brush tank. *(This activity is required for turntable type machines only)*	
Checking and refilling of colourants is the most important activity. One can do that by checking with the tinting software. The same should be verified by opening each cannister and checking the physical quantity level.	

Note: After refilling colourants in the cannisters, the tinting software must be updated manually as there is no communication between the tinting machine and computer to automatically record additions. If you do not update the added colourant quantity in the computer, it will show insufficient stock of colourant and the tinting would fail or halt.

2.6.2 Trouble Shooting in Automatic Tinting Machines

Automatic tinting machines are of robust construction and provide trouble free service, provided they are operated well with regular preventive maintenancee. However, sometimes one may face issues, which can be resolved through trouble shooting actions. Given below is a table of common issues with probable reasons and corrective measures.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Message on the screen: Tinting system busy	• The tinting software might have been opened twice.	• Restart the computer. • If the problem continues, call the service centre of the machine manufacturer.
Message on the screen: Can missing	• Problem with the sensor.	• Cover the sensor with a card board and tint. • If the problem continues, call the service centre of the machine manufacturer.
Stainers over flowing from canisters	• Excess stainer poured into the canister.	• Call the service centre of the machine manufacturer.
Stainer dripping from canister	• Trapped air in the pipes, connected to the nozzle.	• Drain out 500 ml of stainer in a clean, empty can. This will allow the air bubbles to pass. • If the problem persists, call the service centre of the machine manufacturer.
Machine not working after switching on	• No power supply • Defect in electrical connections	• Check all power connections. • If the problem persists, call the service centre of the machine manufacturer.

2.6.3 Manual Tinting Machines

In manual machines, only daily activities mentioned above under automatic tinting machines are required to be carried out. Purging option is specific to the automatic tinting machines and not required for manual tinting machines.

Gyroshaker: Most gyroshakers are built to work flawlessly for several years and do not give any major problems in day to day operation. Minor operational issues that occur can be dealt with immediately with some basic troubleshooting knowledge. Given below is a table for some common issues with reasons and corrective measures.

DEFECTS	PROBABLE CAUSE	CORRECTIVE ACTION
Gyroshaker not responding	• Machine tripped due to high load.	• Check the MCB and switch it on again. • Reduce load, allow it to cool before switching on again.
Top handle movement jerky	• Unclean guide rods due to dirt, dust or paint.	• Clean the guide rods, remove any dry paint with thinner. • Lubricate them with oil for smooth movement.
Belt slipping/cut	• Belt has worn out.	• Replace the belt.
Vibration in gyroshaker	• Installation on uneven floor.	• Place the gyroshaker on a plain, levelled surface. • Install dampeners, if required, to circumvent unevenness of the floor.
Drum slipping	• Improper placement or worn out rubber pads	• Place the drum properly. • Replace damaged or worn out rubbers pads.

Maintaining a gyroshaker is simpler compared to the tinting machine. There are only following two activities, to be doned **WEEKLY** for keeping the gyroshaker in good running condition.

WEEKLY MAINTENANCE

- Cleaning and oiling of the guide bars of gyroshaker for smooth, resistance free movement.
- Cleaning of paint deposited on rubber pads and guide rods.

GENERAL PRECAUTIONS

- Check out for the wear and tear of all the cables and connectors to prevent electrical shocks or improper communication between the machine and the computer.
- Carry out regular general maintenance as recommended by the supplier.
- Maintain hygiene / cleanliness of the machine for smooth operations.
- Maintain hygiene / cleanliness of the work area.

SAFETY TIPS

- Follow all recommended safety precautions, including any specific safety precautions to be taken while using the tinting system

- Ensure overall safe work environment

Certain parts of the gyroshaker need periodic replacement due to wear and tear. These can be replaced very easily. However, should you face any issue it is best to contact the service centre for help.

Tips

- Today the choice of colours/shades for decorative and automotive paints has widened considerably. Most paint manufacturers now offer 1500+ colours/ shades for household painting and that too in various categories of paint.

- Offering this wide variety of colours would not have been possible with the earlier practice of selling readymade colours, due to huge inventory requirements. This has been possible only with the use of tinting machines.

- Initially, manual tinting machines were introduced. With the introduction of automatic tinting systems, the colour consistency and accuracy has increased tremendously.

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PAINTS AND
COATINGS
SKILL COUNCIL

3. Undertake Counter Sales and Manage Customers

Unit 3.1 - Attending to Customers

Unit 3.2 - Attending Customer Complaints

Unit 3.3 - Maintaining Stock Records

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Applicable NOS – PCS/N5009

Key Learning Outcomes

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

1. Advise the customer regarding different products and colour combinations
2. Solve customer complaints
3. Model the right inventory system for the products

UNIT 3.1 Attending to Customers

Unit Objectives

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

1.   Categorize product/shade combination on usage, manufacturer and cost
2.   Demonstrate product-shade combinations available
3.   Demonstrate colour combinations for interior and exterior use

As a shop tinting assistant, you may need to attend to customers and explain the various product and brand options that are available for interior and exterior use, i.e. distemper, acrylic emulsion, premium emulsion, luxury emulsion, lustre finish, textures and special finishes etc. Likewise, in the case of automotive paints too, there are different products available at various price points. You must be aware of the quality, finish and performance aspects of these products and guide the customer to a correct choice keeping in mind his performance requirement and budget.

For exterior paints, you should be aware of special properties offered by different products/ brands. Some of these special properties are UV resistance, anti-algal and anti-fungal performance, dirt pickup resistance, water-proofing or elastomeric property, and durability. The warranty offered by the paint manufacturer is also an important consideration.

You should also be able to guide the customer on different options of light/pastel, mid tones and dark shades available and combinations of these. This can be done by displaying the colour brochures provided by the paint manufacturers. It can also be displayed on the computer screen, if a suitable software is installed. Shade cards and fandeck too can be used as a good guide for showing complimentary and contrast colours of a particular colour family. Most customers are not aware of the different types of paints available and their characteristics. A good shop tinting assistant can guide the customer to use the right product in the budget that suits the customer's pocket. A satisfied customer will become a loyal customer for repeat purchase and also provide word of mouth publicity for the dealer.

Goods Return Policy: One of the most important issues in colour prepared as per customer's specific choice is that it cannot be sold to another customer, in case the original customer wants to change or return the colour after tinting. For this reason, the shop tinting assistant should very humbly inform the customer, before preparing the colour, that it would not be possible to change or take the product back after tinting. A good practice would be to re-confirm the colour chosen by the customer, by showing the shade/ Fandeck once again and also on the computer screen, when the formula for the colour is accessed. This is very important from the point of view of avoiding disputes and preventing unsaleable inventory.

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UNIT 3.2 Attending to Customer Complaints

Unit Objectives

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

1. Build a system for recording customer complaints
2. Solve customer complaints appropriately

Sometimes a customer may face some issues with the product and raise a complaint with the dealer. One needs to handle this in a sensitive way as otherwise it could lead to overall dissatisfaction of the customer and damage the reputation of the shop or the brand.

As a shop sales person you should record customer complaints in a proper manner and try to resolve it at your or the shop level. A quick resolution can leave the customer satisfied.

However, if the complaint relates to the product or quality which needs to be referred to the manufacturer, it should be escalated immediately with a proper procedure and records so as elicit timely response from the company. In such cases, the customer should be made aware of the standard procedure of the company in resolving the issue. This would give the customer a clear understanding of the complaint handling process, the steps involved in resolving the issue and the expected time frames for resolution of the complaint by the company.

A good understanding of quality expectations from paint products can be obtained from Chapter 5. This will help you deal better with customer complaints and act as a bridge between the customer and the manufacturer for a speedy resolution of the complaint.

The shop sales person should regularly follow up with the paint manufacturer on the progress of the complaint and keep the customer informed. Maintaining clear and open communication with the customer always helps retain the trust of the customer in the shop and in the manufacturer.

There could be instances when the customer complains about the shade not matching with his chosen shade. The simple way to check this is to take a card paper, apply the prepared colour on it, allow it to dry and then match the colour against the shade card/fandeck. In case the prepared colour does not match with the standard or the customer's choice, the colour needs to be re-tinted.

Some paint manufacturers may offer software for matching/ correcting the colour using a standard panel/ tab. After reading the colour using a spectrophotometer, the computer generates suggestions for colourants and quantity to be added, to correct the colour.

The manual process of colour correction is highly dependent on the person's expertise, judgement and natural instinct and eye for reading colours. One can develop this over time with experience of tinting more and more colours and studying them thoroughly.

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UNIT 3.3 Maintaining Inventory

Unit Objectives

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

1. Build a system for recording in-coming goods and sale
2. Identify fast moving and slow-moving product-shade combinations and fix minimum and maximum stock limits
3. Compare the book stock with physical stock periodically

An important responsibility of a Shop Tinting Assistant is to maintain proper inventory of base, colourants and other items required. Since, there are many different products, bases and colourants, of different manufacturers, it is necessary to maintain a record of all these. The inventory record can be maintained manually in a register (See table below), for each and every SKU (Stock Keeping Unit) or in the computer system using commercially available software. In the latter case, the shop tinting assistant should learn the programme and maintain the stock.

The records should be immediately updated either on consumption or receipt of fresh supplies. e.g. reducing the stock of the SKU on sale and increasing on the receipt.

The minimum and maximum stock level for each SKU (Stock Keeping Unit) should be defined depending on the sale or popularity of the product/colour.

As an example, if colourant Yellow Oxide shows the highest consumption colourant among all colourants, the minimum stock level for it should be much higher than the maximum defined for the slowest moving colourant. When the inventory for a particular product/ colour reaches the defined minimum stock, it is re-ordered either issued manually or through the system.

Periodically, the book stock (manually maintained or through the system) should be checked against the physical stock in the shop or warehouse and reconciled at regular intervals, say at least once a month.

Tips

- Paint manufacturers supply different products for different end uses eg. interior masonry surfaces, exterior masonry surfaces, wood, metal etc. A number of shades/ colours is offered for each product.

- Customer complaints on wrong colour, poor quality product are mostly lodged with the dealer/ paint seller. Initial analysis should be carried out at the dealer shop before forwarding it to the manufacturer.

- Some product-shade combinations will be fast moving while some will be slow moving. Proper inventory management will ensure faster turnover of the products.

4. Coordinate with Colleagues and Customers

PAINTS AND
COATINGS
SKILL COUNCIL

Unit 4.1 - Interacting with Superior

Unit 4.2 - Communicating with Colleagues

Unit 4.3 - 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 4.1 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.

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UNIT 4.2 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 4.3 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.

- 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.

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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.

4.3.1 Quality and Service Orientation

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.

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4.3.2 Customer Satisfaction

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.

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PAINTS AND
COATINGS
SKILL COUNCIL

5. Maintain Standards of Product / Service Quality

Unit 5.1 - Meeting and Exceeding Customer Expectations

Unit 5.2 - Coating Defects, Tests and Standards

Unit 5.3 - Your Responsibility as a General Industrial (Liquid) Painter

Unit 5.4 - 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 general industrial painting

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 painting job done

UNIT 5.1 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 coating 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

5.1.1 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.

(a) On visual inspection, the coating should show the desired finish and correct curing without defects or blemishes.

(b) Mechanical strength checks are performed to ascertain that the DFT (Dry Film Thickness), hardness and flexibility criteria are met

(c) The film is tested for corrosion resistance. This may include salt spray resistance test, humidity resistance test etc.

(d) Outdoor durability tests include ultraviolet resistance test and actual outdoor resistance test

UNIT 5.2 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

5.2.1 Tests and Standards to Check Quality

• Dry Film Thickness (DFT) measurement

• Gloss

• Colour

• Flexibility / bend test

• Pencil hardness test

• Adhesion test

5.2.1.1 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) & standard thickness plastic foils (shims) which are supplied with the gauge

- Different gauges are available for Ferrous and Non-Ferrous substrates (F and NF)

Fig 5.2.1.1 (i): Magnetic Gauge   *Fig 5.2.1.1 (ii): Digital Gauge*

5.2.1.2 Gloss Check

- 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 common

Fig 5.2.1.2: Gloss meter

5.2.1.3 Colour Check

Colour may be checked visually or using a computer aided spectrophotometer. If measured by a spectrophotometer, the colour difference is reported as ΔE (Delta E). The ΔE 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
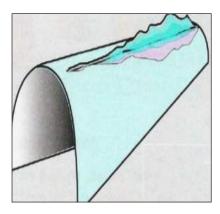
Fig 5.2.1.3: Spectrophotometer

5.2.1.4 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.

- 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
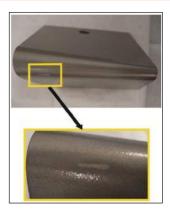
Fig 5.2.1.4: Bend test on a conical mandrel

5.2.1.5 Pencil Hardness Test

Fig 5.2.1.5: 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. Mitsubishi UNI pencils are international industry standard.
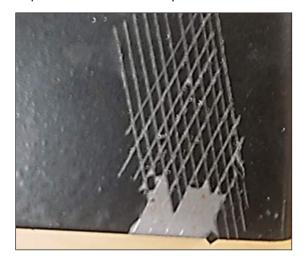
Softer Pencils							Harder Pencils						
6B	5B	4B	3B	2B	B	HB	F	H	2H	3H	4H	5H	6H

5.2.1.6 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.
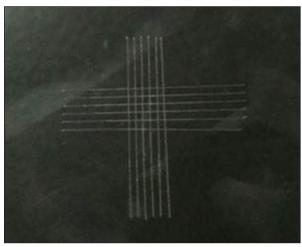
Fig 5.2.1.6 (i): Adhesion test fail   Fig 5.2.1.6 (ii): Adhesion test pass

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
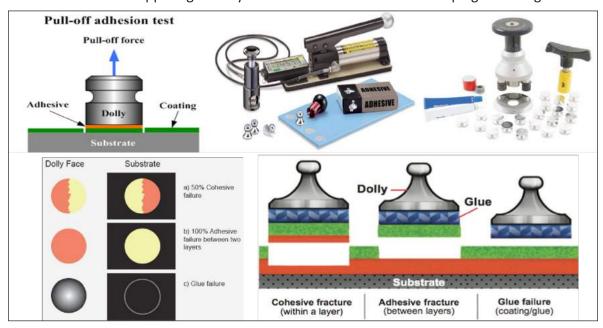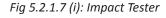
Fig 5.2.1.6 (iii): Pull-off Adhesion Test

5.2.1.7 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

Fig 5.2.1.7 (i): Impact Tester
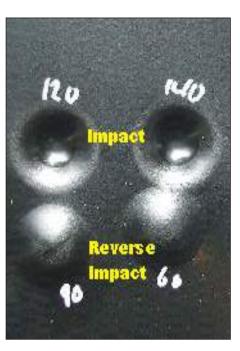
Fig 5.2.1.7 (ii): Impact Test

5.2.2 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	**RUNS AND SAGS**	• Over thinned paint • Use of very slow evaporating thinner • Applying paint without proper flash time between coats • Very low air pressure during spray application • Improper spray gun set-up or an unbalanced spray pattern • Very cold substrate

| 2	**CHALKING**	• Chalking is a surface phenomenon, generally caused by exposure to UV radiation produced by the sun and its action on the organic binder
		• 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
		• 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
		• 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
3	**EROSION**	• 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
		• 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
		• Erosion of internal linings can be a significant problem in pipes carrying slurry or cooling water
		• Resins with some elastomeric quality may be effective, providing resilience to combat the impact of the eroding particles
4	**CHECKING**	• 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
		• It is a surface phenomenon that does not go all the way to the substrate
		• It can be caused by the mixture of resins, solvents and pigments that are not compatible.
		• Excessive film thickness, low flash off between coats, inadequately dry or thick undercoat are also some of the causes for checking
		• 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
		• Apply thinner coats of paint with adequate flash off or drying between coats
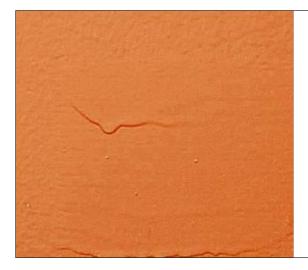
5	ALLIGATORING	• It is mostly a formulation-related failure and prevention is a matter of selection
		• The coating system selected should not specify a soft primer under a harder topcoat. The coating should be applied in thin coats, which should be allowed to cure before application of successive coats
		• Never apply a hard coating that oxidises or requires polymerisation over a permanently softer or more rubbery primer
6	CRACKING	• This formulation related failure is due to premature aging or weathering and, unlike checking or alligatoring, the cracks break through the coating, extending to the substrate
		• Cracking is a much more serious type of failure than checking
		• Checking results from the stress on the coating surface, while cracking results from stress throughout the film and between the film and the substrate
		• The use of proper resins, plasticizers, and pigments in coating formulation minimises the tendency of the coating to cracking
		• Fibrous or acicular (needle shaped) reinforcing pigments can help in reinforcing the coating against cracking
7	MUDCRACKING	• Unlike alligatoring, mudcracking goes directly to the substrate. It presents an immediate corrosion problem with possible chipping and flaking of coating from the surface
		• It occurs when highly filled or pigmented coatings, particularly zinc rich coatings are applied too thick
		• 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
		• 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.
		• The coating should be applied during more moderate drying conditions, in thin coats without runs and sags
8	WRINKLING	• Wrinkling generally occurs when coatings are applied too thick.
		• 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
		• Occurs most with oil-based coatings
		• If a coating contains an excess of surface driers, wrinkling may occur wherever the coating is thicker than normal
		• 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

9	**BLISTERING**	• Blister develops first in localised spots where the adhesion is weakest
		• Blisters can be large or small and may exist in isolation or in groups
		• 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
		• 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.
		• Yet another cause could be inadequate solvent release by the coating
10	**INTER-COAT DELAMINATION**	• 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
		• New coatings applied over existing coatings may not be compatible with the previous coating, and delamination can occur
		• Precautions should be taken to minimise the problem by cleaning adequately and by applying coatings as quickly as possible after the cleaning operation
		• Another cause of delamination is the application of a coating over another coating that has over cured
		• Some modern coating formulations have been specifically developed with a low cross-link density to reduce this problem
11	**EXCESSIVE ORANGE PEEL**	• 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
		• The oven temperature should cross 120°C -140°C very quickly
		• Grounding should be checked
		• The kV setting of the spray gun to be lowered
		• 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.
		• In air assisted spray, the recommended air pressure should be maintained
12	**GLOSS TOO LOW FOR HIGH GLOSS TYPE COATING**	• Incompatibility between different coats
		• Micro-pinholing from outgassing
		• Excessive orange peel due to inadequate DFT
		• Over-curing of parts

13	INCONSISTENT FILM THICKNESS	• Incorrect positioning of spray guns
		• Defective spray equipment / nozzle
		• Reciprocators not matched to line speed
		• Air flow in booth disturbing spray pattern
		• Improper manual technique
14	POOR IMPACT RESISTANCE AND/ OR FLEXIBILITY	• Over baked film
		• Poor cleaning
		• Excessive film thickness
15	POOR ADHESION	• Poor cleaning / pretreatment
		• The PT line is not properly maintained
		• Oil removal from the degreasing stages not proper
		• Under-cured film
16	PINHOLES	• Moisture in coating
		• Moisture in compressed air
		• Mixing of two different coating types
		• Porous component like casting
		• Heating too fast creating outgassing while curing
17	CISSING OR CRATERS	• Moisture in coating
		• Oil in compressed air
18	CHIPPING	• Loss of adhesion of the film to the substrate due to impact from stones or other hard objects
		• Sand and featheredge damaged areas to remove chips, then refinish.
		• Use premium two component undercoat and topcoat system.
		• Use a flex agent in undercoat and/or topcoat system in areas that are prone to chipping.
19	DUST CONTAMINATION	• Inadequate cleaning of the surface
		• Dirty spray environment
		• Inadequate air filtration in the booth
		• Use of poor grade masking paper
		• Dirty spray gun
		• Dirty work clothes
		• Fine dust contamination can be removed by sanding and polishing

20	**FISHEYES**	• Spraying over surfaces contaminated with oil, wax, silicone, grease etc.
		• Use of thinner/ reducer in place of a solvent cleaner Spraying over previously repaired areas containing fisheye eliminator additive
		• Remove wet paint film with solvent cleaner and refinish. Add recommended fisheye eliminator and respray the affected areas.
		• Do not use fisheye eliminator in undercoat or basecoat colour.
		• If the paint has dried, sand to a smooth finish below the fisheye cratering and refinish
21	**LOSS OF GLOSS**	• Top coat applied in heavy, wet coats
		• Inadequate flash time between coats
		• Insufficient film thickness of topcoat colour or clearcoat
		• Using a poor grade and/or too fast evaporating thinner
		• Improper cleaning of the substrate
		• Insufficient air movement during and after application
		• Spraying over a deteriorated or solvent sensitive substrate finish without proper priming or sealing procedures
		• Natural weathering of the finish
		• Allow finish to cure thoroughly, compound or polish to restore gloss.
		• Sand and refinish
22	**MOTTLING**	• An uneven distribution of metallic flake
		• Too much thinner/reducer
		• Colour overthinned/ reduced
		• Applying clear coat to a basecoat that has not thoroughly flashed/dried
		• Improper application of basecoat
		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
23	**SANDING MARKS**	• Scratching or distorting metallic/mica flakes close to the surface of the paint film
		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

24	**SOFT FILM**	• Applying undercoat and/or topcoat excessively wet
		• Insufficient dry time between coats
		• Improper shop ventilation or heating
		• Adding too much or too little hardener to the paint material.
		• Using the incorrect thinner/reducer for spray conditions
		• Omission of drier in enamel/ urethane topcoat
		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.
25	**BLEEDING**	• Solvent in the new topcoat dissolves soluble dyes/pigments in the original finish, allowing them to seep into and discolour the new topcoat.
		• Remedial measures can be to remove original paint film and refinish.
		• Preventive measure can be to isolate the suspected bleeding finish by applying a two-component surface/sealer.
		• Allow to cure and then apply desired topcoat.
26	**TRANSPARENCY**	• Paint not thoroughly stirred
		• Colour over thinned/reduced
		• Substrate not uniform in colour
		• Wrong colour undercoat used
		• Insufficient number of colour coats applied
		Apply additional coats of colour until hiding is achieved or sand and apply similar coloured undercoat/ground coat and refinish.
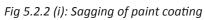
Fig 5.2.2 (i): Sagging of paint coating   Fig 5.2.2 (ii): Chalking
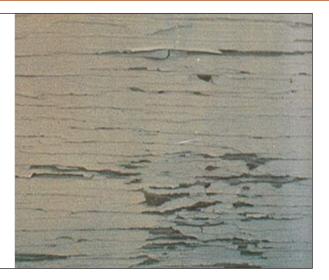
Fig 5.2.2 (iii): Erosion
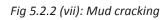
Fig 5.2.2 (iv): Checking

Fig 5.2.2 (v): Alligatoring

Fig 5.2.2 (vi): Cracking

Fig 5.2.2 (vii): Mud cracking
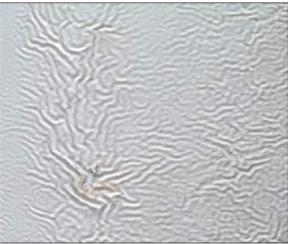
Fig 5.2.2 (viii): Wrinkling

Fig 5.2.2 (ix): Blistering

Fig 5.2.2 (x): Inter-coat delamination
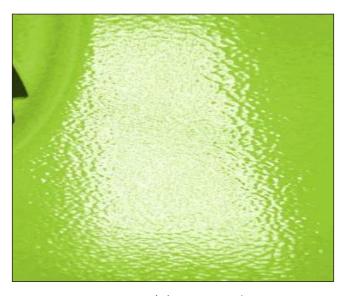
Fig 5.2.2 (xi): Orange peel
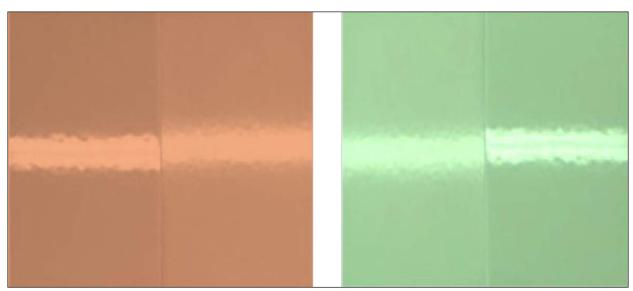
Fig 5.2.2 (xii): Standard Gloss Lower Gloss

Fig 5.2.2 (xiii): Standard Gloss Higher Gloss

Fig 5.2.2 (xiv): Varied DFTs mentioned on panel
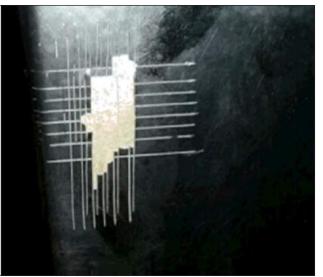
Fig 5.2.2 (xv): Poor pencil adhesion

Fig 5.2.2 (xvi): Impact Reverse Impact

Fig 5.2.2 (xvii): Failed impact test
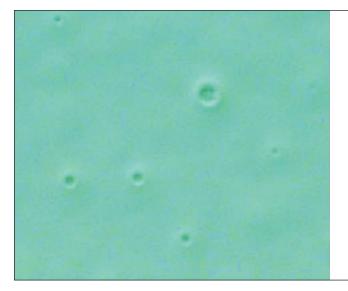
Fig 5.2.2 (xviii): Pinholes
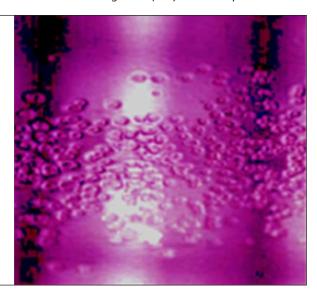
Fig 5.2.2 (xix): Cissing or craters
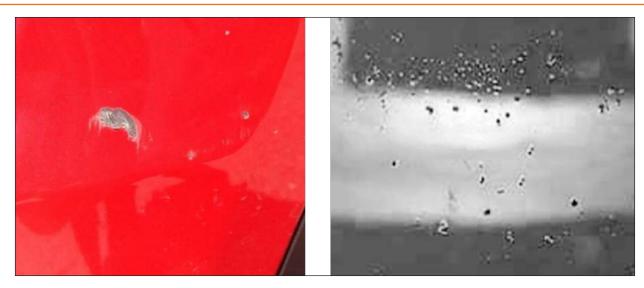
Fig 5.2.2 (xx): Chipping

Fig 5.2.2 (xxi): Dust contamination
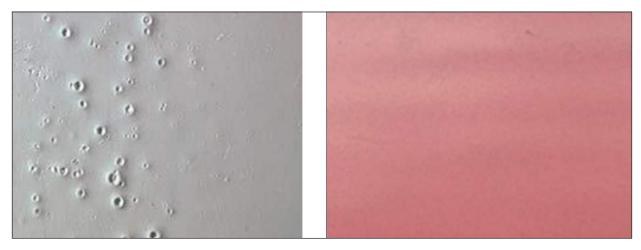
Fig 5.2.2 (xxii): Fisheyes

Fig 5.2.2 (xxiii): Loss of gloss

Fig 5.2.2 (xxiv): Mottling

Fig 5.2.2 (xxv): Sanding marks
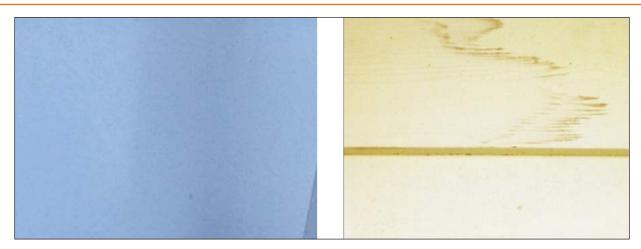
Fig 5.2.2 (xxvi): Soft film   *Fig 5.2.2 (xxvii): Bleeding*
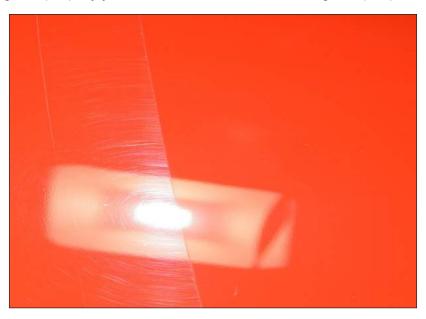
Fig 5.2.2 (xxviii): Transparency

Notes

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UNIT 5.3 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 tipguards, 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 spraygun 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

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6. Maintain OH&S Standards and Follow Environmental Norms

PAINTS AND COATINGS SKILL COUNCIL

Unit 6.1 - Responsibility Regarding Safety

Unit 6.2 - Waste Disposal

Unit 6.3 - Use Safety Tools and Personal Protective Equipment (PPE)

Unit 6.4 - Handling of Coating Materials and Equipment as per Safety
and Environmental Standards

Unit 6.5 - 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 6.1 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.

6.1.1 Primary Hazards

Fire	Explosion	Reactivity	Health Hazards
• 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.	• 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.	• 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.	• 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.

6.1.2 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.

6.1.3 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.
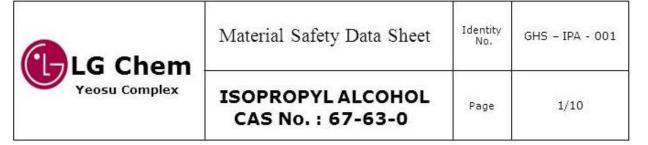
The MSDS lists each required substance that makes up more than 1 per cent of the product. However, if the chemical causes cancer, respiratory sensitisation, or reproductive effects, then it must be listed even if it makes up more than 0.1 per cent.

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.

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

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

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 (anitseptic 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 : 061-680-1331
  ○ 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 6.1.3: Material Safety Data Sheet (freeenergystore.com)

UNIT 6.2 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.

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UNIT 6.3 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
• Use Personal Protective Equipment (PPE) to limit exposure to the eyes while handling powders or while spraying paint • Use regulated air respirator while spraying • Position yourself upwind of object being sprayed	• Use ladders that are stable • Wear shoes with heels • Inspect for loose, worn, or damaged rungs • Do not carry any tools in hand while climbing • While climbing face ladder, never jump from a ladder • Guard against metal ladder coming in contact with electric power lines	• Inspect for damage or deterioration • Ensure scaffolding is plumb and level • Ensure handrailing is provided on all scaffolding	• Verify safety guards are fitted and operational • Dust collection systems are operational when working with hazardous materials

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 powder coating operator should not use gloves as his hand should connect to the spray gun for grounding of his body.

Fig 6.3 (i): Latex gloves for pretreatment
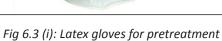
Fig 6.3 (ii): Gloves for component handling

2. **Masks**

    •   **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

Fig 6.3 (iii): Worker with a mask

3. **Ear plug/Muff**

    •   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

Fig 6.3 (iv): Ear plugs

4. **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

Fig 6.3 (v): Eye shield

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)**

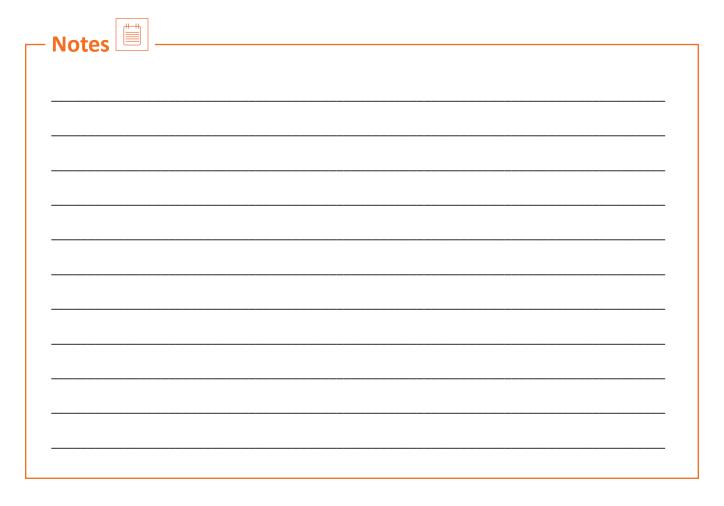   They are used while working on the shop floor.

Fig 6.3 (vi): Safety precaution chart

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UNIT 6.4 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
• Read the MSDS. • Avoid excessive skin exposure. • Wear proper respiratory equipment. • Wear proper clothing and eyewear. • Always follow the manufacturers written procedures.	• Read the MSDS • Avoid skin contact • Wear recommended safety clothing • Maintain good ventilation • Always stay alert while handling chemicals	• Eliminate sources of ignition • Maintain a safe concentration of powder/ solvent vapour in air-below 50% of the lower explosion (flammability) limits • Maintain a good ground throughout the racks • Maintain a good ground on everything in the electrostatic coating application system	• Allow the temperature to attain the room temperature before carrying out any work • Disconnect power before entering • Use good lighting when entering • Wear a hard hat in areas where it is necessary to stoop • Never open washer or oven during operation • Know the hazards inside the equipment

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

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UNIT 6.5 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

6.5.1 Ergonomic Lifting, Bending or Moving Equipment and Supplies

Fig 6.5.1 (i): Correct lifting techniques (worldartsme.com)

6.5.2 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

6.5.3 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 plans 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 numbers 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
- Learn facility alarms, evacuation
- procedures and general emergency
- protocols

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 (Supervisor, fire safety warden etc.)

MEDICAL EMERGENCY
- Person trained in CPR (**Cardiopulmonary resuscitation**) must be contacted
- Dial emergency number to contact hospital and ambulance
- Inform supervisor
- Inform family members

6.5.4 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

6.5.5 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

GENERAL SAFETY	• Locate nearest telephone • Identify restricted areas • Locate fire alarm • Locate fire extinguisher and fire blankets • Locate moving objects, cranes, and traffic • Identify and observe safety warning tags and signs • Learn facility alarms, evacuation procedures, and general emergency protocols
LADDERS	• Periodically inspect for loose, worn, or damaged rungs • Never carry any tools in hand while climbing • Always face ladder while climbing • Never jump from a ladder • Guard against danger of metal ladder coming in contact with electric power lines • Secure the ladder
SCAFFOLDING	• Periodically inspect for damage or deterioration • Ensure scaffolding is plumb and level • Ensure handrailing is provided on all scaffolding • Never ride scaffolding on rollers when it is being moved • Verify inspection tags are valid and in place at all times
POWER TOOLS	• Ensure safety guards are fitted and operational • Ensure dust collection systems are operational when working with hazardous materials

ABRASIVE BLAST	• Ensure that the following are installed and in working order:
	  o Deadman valve
	  o Pressure control valves
	  o Adequate moisture and oil separators
	  o Protective clothing (hoods and gloves)
	  o Filtered and regulated air-supplied respirator
	• Make certain that:
	  o Entire system is grounded, including hoses, operator, and work piece
	  o Hose couplings are wired shut
	  o Abrasive hose is stored in a dry place
	  o Abrasive hose is curved around, not bent at 90° angle
	  o Nozzle is never pointed at human body or breakable object
	  o Abrasive hose is inspected for damage and wear

SPRAY APPLICATION	• Ensure no ignition sources are present
	• Minimise use of low flash point materials
	• Adequate ventilation must always be provided
	• Ensure spray booth is clear of exhaust fumes from previous spraying
	• Ensure no rags become soaked with flammable liquid in spray area
PERSONAL PROTECTION	• Goggles and safety glasses must be worn at all times
	• Regulated air respirator must be used always
	• Operator must always be positioned upwind of object being sprayed
HOSE AND GUN	• Hoses must be inspected periodically for weak and worn spots
	• Hose connections must be correct and tightened
	• Hose must never be disconnected or recoupled while under pressure
	• Pressurised unit must never be left unattended
	• Gun must be grounded through hose connections
	• Operator uses electrically conductive hose in airless applications.
TEST EQUPMENT	• Holiday detectors must always be grounded
	• No volatile substances must be present when high voltage detectors are in use
	• Equipment must be suitable for the environment in which it is being used, e.g., intrinsically safe in hazardous confined spaces

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