

## SPRAY PAINTING PLANT

A chemically resistant, mechanically durable, pleasant in appearance and finish painting is sought for by all quality seekers. Design constraints of product, customer preferences, and local government regulations related to environmental control - all affect the painting process decisions. A close and effective interaction between the concerned experts, paint process plants, paint application equipment, and paint as well as chemical plant/s are essential for achieving the highest possible paint-shop efficiency. Other goals are the best of product quality, minimum unit production cost, and conforming to emission control requirements. A high degree of automation has become a necessity for consistency in quality and to avoid the hazardous working environment demanded by the painting processes.

### **PRODUCTION SEQUENCES OF PAINT SHOP**

The typical processes to be followed in the paint shop are as follows:

*Precleaning*

*Multistage Phosphate Pretreatment*

*Primer coating*

*Top coat*

Precleaning removes the dust, dirt, oil and rust. Phosphate pretreatment assists good paint adhesion and resistance against corrosion. Uniform primer coating on the surface helps smoothing of any roughness of the surfaces and the top coat determines the visual appearance of the car.



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## **PRECLEANING**

At precleaning stage, heavy contamination of component is removed to extend the life of degreasing baths of pretreatment stages. Methods followed for precleaning, may be:

1. Manual precleaning with high pressure devices
2. brush (3M Scotch-Brite pads) cleaning using some chemical
3. low and high pressure spray cleaning or,
4. combination of 1~3 methods

## **MULTI STAGE PHOSPHATE PRETREATMENT**

Pretreatment is carried out in number of stages. All surfaces of the component are thoroughly cleaned and degreased before the application of zinc phosphate (Low zinc, nitrate free process is the present trend), as the improper cleaning inhibits the proper phosphating of surfaces.. Main objective of phosphating is for good paint adhesion and to assist to protect the metal surface against corrosion. Phosphate coating texture, crystal size, morphology, and coating weight are controlled and manipulated by proper surface conditioning for the desired quality out of pretreatment process. Between these stages, the components pass through rinse zones. At the end of pretreatment line, passivating is carried out, and a final rinsing is done with fresh demineralised (DM) water. Every care is taken to prevent the contamination of solutions and rinsing tanks. Typically, the stages of pretreatment system and the parameters are as follows:

No.	Process	Method	Temp, °C	Process (drain) time, min
1				
2	Pre-degrease	spray / dip	50-70	1-2 (1)
3	Degrease	Spray / dip	50-70	6-8 (1)
4	Water rinse 1	spray / dip	ambient	1 (1)
5	Derust	dip	40-50	3-4 (2)
6	Water rinse 2	spray / dip	ambient	1 (1)
7	Water rinse 3	spray / dip	ambient	1 (1)
8	Activation	spray / dip	ambient	1 (1)
9	Phosphate	Spray / dip	45-50	3-4 (1.5)
10	Water rinse 4	spray / dip	ambient	1 (1)
11	Passivation	Spray / dip	30-40	1 (1)
12	Water rinse 5	spray / dip	ambient	1 (1)
13	Clean DM rinse	spray / dip	ambient	(1)

After spray painting and flash off, the component is moved through an oven for about 30 minutes at about 140° C for baking of primer. The components before moving to top coat are wet sanded, rinsed, and dried off. A preparation area is used for manual wipe down, compressed air blow-off and deionised air application. Depending on the manufacturer’s process plans either the component moves through a clear coat application booth or a two-coat (basecoat/clear coat) booth. Between each coat, a flash off is necessary. The bodies are baked for about 30 minutes at around 140° C.

Some unique differences in processes are observed from manufacturer to manufacturer.

While painting is carried out in booths, the component moves through oven for baking. Painting booths and ovens are specially designed to meet the quality requirements.

## PAINT BOOTHS

Different stages for spray booths of various processes are typically as follows:

Sealer/Finish	Metallic Finish Coat	Final Repair
1. Tac-rag zone 2. Primer first coat 3. Flash -off	1. Tac-rag zone 2. Top first coat 3. Top second coat 4. Flash-off	1. Tac-rag 2. Manual spray 3. Flash-off

## OVENS

After every paint coating, ovens are required to cure the coating in addition to drying off the wet surfaces. The type of oven system generally depends on the type of paint used. Typically in a paint shop, the ovens are: pre-treatment water dry-off oven, primer coat oven, dry-off oven after wet sanding, finish coat oven and finish coat oven.

Dry-off ovens are used to ensure that the body surfaces are absolutely dry before paint application. Sufficient time is provided to allow the body to be heated to about 70-80°; at which all water is evaporated. Ventilation is necessary to take away the evaporated water. With direct gas heaters, ventilation must be sufficient to provide the amount of oxygen required for the combustion as well to take away the flue gas produced.

Paint bake ovens are divided in two parts: the heat-up zone and the holding zones followed by the cooler. Air seals are incorporated at oven ends. In heating zone, the painted bodies are rapidly brought up to the required baking temperature. The holding zone then maintains the temperature of the bodies for the time required for complete baking of the paint.

Convection ovens or radiation heat ovens, may be used in paint stoving process.

**Convection ovens:** The component is heated by means of circulating air that sweeps over the surface thus transferring its heat to the body by convection. For a uniform metal temperature, the circulating air is blown into the oven at floor level. The air then is made to pass through the oven vertically towards the ceiling from which it is extracted and conveyed back to the heating unit.

**Radiation ovens:** Due to the natural air circulation caused by the heat convection against the radiation panels, there is a tendency of temperature increase just below the oven ceiling in radiation oven. A supplementary air circulation fan is used to exhaust the hot air under the ceiling and blow it again at floor level to maintain an even temperature inside the oven.

### **MATERIAL HANDLING SYSTEM FOR PAINT SHOP**

Selection of the appropriate conveyance method for each process is vital and depends on the layout. The system may combine several types of conveyors and other handling and storage equipment. Component-in-white from fabrication shop is transferred to overhead conveyor that moves the component through pretreatment, painting booths and ovens. Specially designed hangers along with dirt trays are used to protect



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the conveyors from chemicals and water during the pre-treatment stages, and to protect the possibility of any contamination. Counter measures against chemicals and heat are taken through heat resistant grease for chain trolley-rollers and carrier rollers. The conveyor systems may be electric overhead chain conveyor, monorail or dip tank hoist for intermittent operation, and overhead or pendulum conveyor for continuous operation.