User's Guide

ELCOAT

Powder Coating Spray Machine

Sigma Plus

Troubleshooting included

User's Manual

We welcome you to the **ELCOAT** family and thank you for purchasing the **Sigma Plus** powder coating system.

Before starting to use the **ELCOAT Sigma Plus** powder coating system, please carefully read all the contents of this user manual. It contains comprehensive and illustrated instructions in a simple and understandable language, explaining the essential information and the operation of all the components of the machine.

This guide will assist you in correctly operating the system, ensuring smooth operation during powder coating. It also provides troubleshooting tips for common problems, helping prevent downtime.

This manual has been prepared with great care to ensure the accuracy of the information. However, the manufacturer reserves the right to make changes at any time without prior notice.

The warranty period starts upon delivery and initial operation of the powder coating machine.

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Safety Tips Before Operating the Machine:

This machine is designed for standard workshop use for powder coating applications and must be used according to these guidelines to prevent accidents.

1: All equipment in the powder coating area, such as the machine, cabin, conveyor, recovery system, and workpiece, must be properly grounded using a grounding wire (Earth).

2: The floor of the coating area should be made of materials that allow electrostatic current to pass, such as iron or even regular concrete, to prevent the accumulation of static electricity.

3: Operators must wear shoes and gloves that conduct electrostatic current. Leather-soled shoes are suitable.

4: The yellow grounding cable must be connected to the grounding bolt on the machine, conveyor system, and workpiece, as proper grounding is crucial.

5: Ensure that all electric cables and hoses for powder and air transfer are protected and remain undamaged during operation.

Sigma Plus Powder Coating Machine

The **Sigma Plus** powder coating system was designed and manufactured based on the principles of electrostatic powder coating, with new modifications compared to the previous models. In electrostatic powder coating process, the powder is fluidized using an airflow. The powder is charged with a negative charge as it leaves the spray gun's nozzle, allowing it to easily stick to the positively charged workpiece. Once the workpiece is coated with powder, it is placed in an oven where it is cured at a temperature range of **180-220 °C** for **10-20 minutes**, forming a uniform and durable coating on the surface, which is physically and chemically resistant.

Photo 1. Sigma Plus Powder Coating Machine

Technical Specifications:

- **Power Supply**: 220V AC, Single-phase.
- **Frequency**: 50-60 Hz.
- **Output Frequency**: 17 kHz.

- **Output Voltage**: 0 - 100 kV.
- **Polarity**: Negative.
- **Compressed Air Consumption**: Maximum 13 cubic meters per hour.
- **Air Inlet Pressure**: 6-10 bar.
- **Permissible Air Humidity**: 1.3 g/m³.
- **Permissible Oil in Compressed Air**: Maximum 0.1 ppm.
- **Powder Output Rate**: Maximum 600 g/min.

Main Components

➢ Control Panel

The control panel is one of the most critical parts of the powder coating machine. It is divided into two main sections: the pneumatic control system (which controls air pressure) and the electronic control system (which sends commands).

In Sigma Plus powder coating system, the system has four air control settings:

- Main Air: Controls the main air pressure.
- Auxiliary Air: Helps control the flow of supplementary air.
- Cleaning Air: Used for cleaning the incoming air.
- Fluidizing Air: Controls the air pressure used for powder fluidization.

These settings directly influence the amount of powder transferred, the consistency of the powder flow, and the distribution of the powder cloud.

Airflow inside the system is controlled by a solenoid valve that receives its command from the electronic system. Once the air enters the system, it is regulated by pneumatic regulators that control the air pressure and its flow into the system.

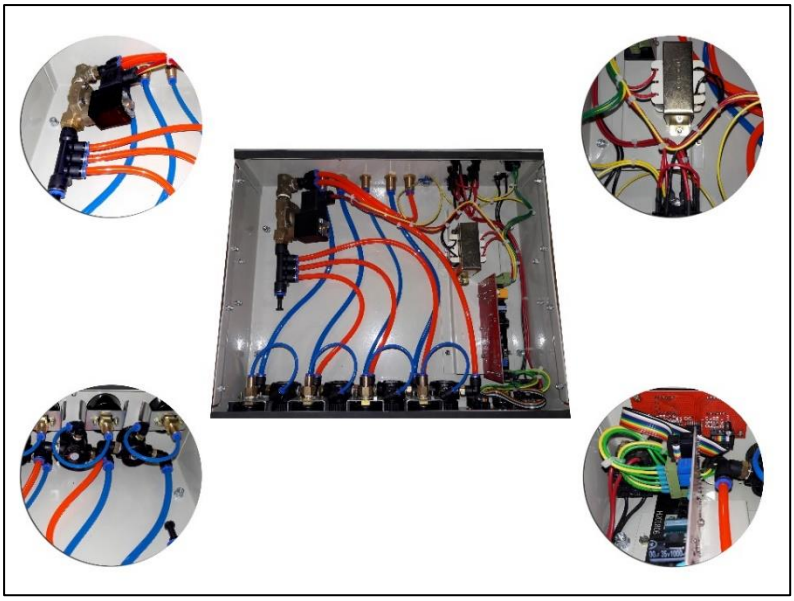

Photo 2. Sigma Plus Control Panel inner view

The main electronic part of the system includes a primary electronic board with a transformer and control switches, which are responsible for sending commands to the rest of the system.The panel indicator is used to indicate the voltage and flow rate. Now, the components of the control panel (front and back view) are introduced.

Control Panel Front view

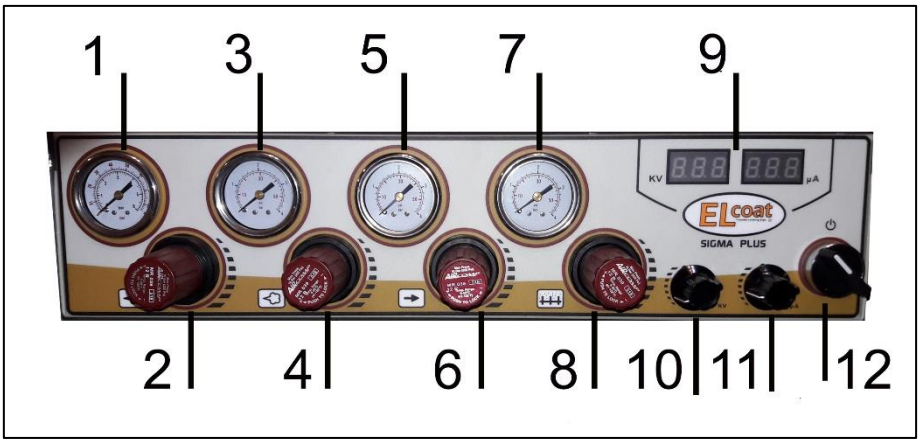

Photo3. Control Panel Front view

1 . Feeding Air Manometer
2. Feeding Air Regulator

3. Dosing Air Manometer
4. Transfer air Regulator
5. Rinsing Air Manometer
6. Cleaning air Regulator
7. Fluidizing Air Manometer
8. Fluidizing Air Regulator
9. Voltage and flow display
10. Voltage change volume
11. Flow change volume
12. Main power

Control Panel Back view

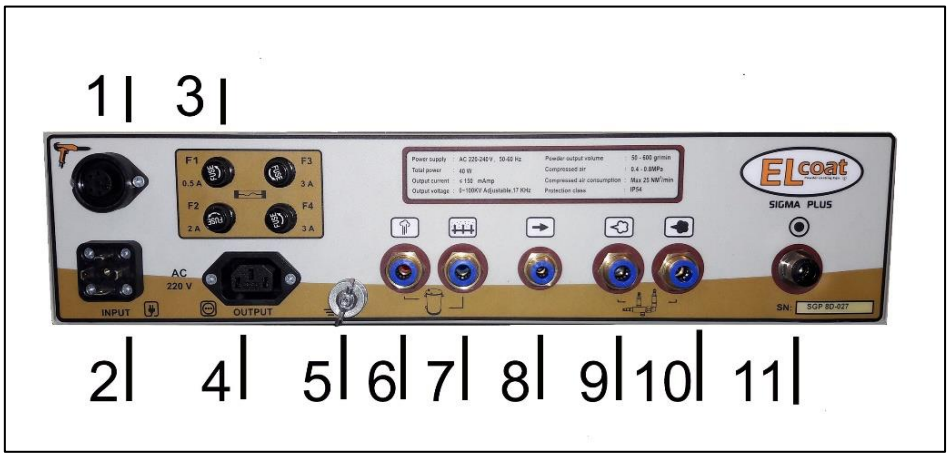

Photo 4. Control Panel Back view

1. Gun Socket
2. Power Input Socket
3. Fuses
4. Vibrator power Socket
5. Earth Connection
6. Air mover Output fitting
7. Fluidize air output fitting
8. Cleaning air output fitting (auxiliary)
9. Transmission air output fitting
10. Powder control output fitting
11. Main air inlet

Two factors that play an essential role in electrostatic powder spraying are: the powder transfer system and the powder charging system.

- **Powder transfer system**

In order to properly transfer the powder to the head of the gun, compressed air is used to fluidize the powder. The components of this system are a vertical pipe, an injector pump, a powder hose and a pneumatic control system that regulates the compressed air pressure. The mechanism is that the main air which controls the volume of the powder coming out of the hopper and the transfer air which controls the intensity of the powder spraying, are sent from the back of the control panel by two hoses of diameter 8 mm are connected to the injector head.

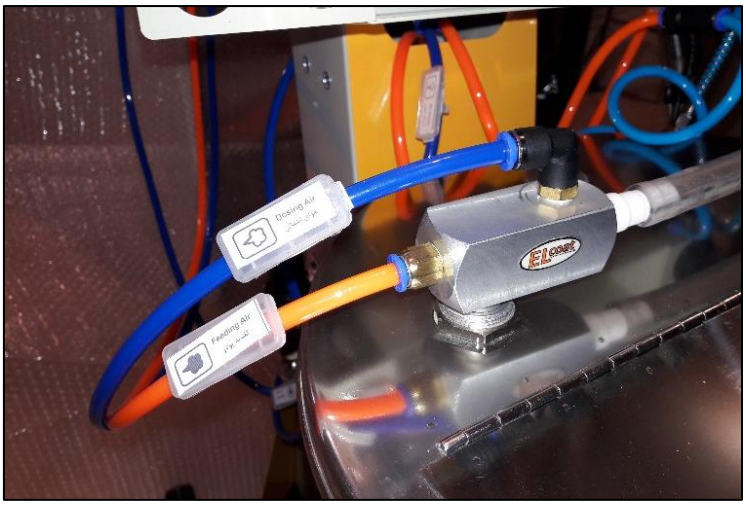

Photo 5. Injector Pump and hoses connections

The injector, according to picture 5, has 3 inputs and one output. 3 inputs include two hoses from the back of the control panel and one input through the powder tube inside the tank and one output of the powder hose which is connected to the end of the gun. The main air and the auxiliary air cause the powder that entered the tank to be sucked into the injector under a relative vacuum, and with the pressure of the auxiliary air and the main air, the powder flow is directed to the end of the gun through the output hose. In simpler terms, the main air helps to suck the powder from inside the powder tube, and the auxiliary air pushes it to the

outside. In this way, the powder cloud is formed in the head of the gun (according to the ratio of the main air pressure to the auxiliary air pressure). If any of the 3 pneumatic parameters (fluidize, auxiliary and main air) are not set correctly, the spraying operation will not be performed correctly.

- **Powder Charging system (spray gun)**

To spray powder on a surface, the powder must be negatively charged. The powder passes through an electric field and sits charged on the part connected to the ground. In charging guns using the corona method, the output voltage of the gun can be changed from zero to 100 kV, depending on the type of powder and the piece to be painted and the distance between the gun and the piece, the amount of voltage can be changed. Precise spray settings are based on the type of part and user's experience. The electric circuit inside the control panel has the ability to convert the electricity input to the device into a voltage with high frequency and low current through a series of electric circuits. This voltage is transmitted by a gun cable and passing through a high voltage converter gate. The powder is charged in the vicinity of the cascade and leaves the nozzle of the gun. When we press the gun trigger, the above circuit and two pneumatic and charging systems are activated. Also, by pressing the gun trigger, the cleaning air cleans the tip of the electrode.

Photo 6. Sigma Plus Spray Gun

➢ **Powder container and fluidization system.**

In order to facilitate the powder spraying operation, a tank equipped with a porous plate known as a fluidizing plate should be used so that the powder paint becomes fluid and the powder suction from the tank and paint spraying can be done properly. In ELCOAT powder spraying system, the powder tank is equipped with a small door at the top of the tank, which allows the user to control the amount of powder inside the tank and the quality of the fluidization, without the powder leaving the tank, and if needed, powder is added into the tank.

Photo 7. Sigma Plus Powder Tank

The powder tank capacity is 25 kg or 65 liters, and its dimensions are 60 cm high and 39 cm in diameter.

The action of fluidizing means mixing compressed air with powder in the powder tank, which helps to separate the powder particles and reduce the moisture content of the powder. The compressed air from the end of the tank, passing through the fluidizing plate, turns the powder into a liquid state.

When the powder is sufficiently fluid, it looks like boiling water. The air pressure settings should be such that the powder does not come out of the tank, because this causes the loss of powder and contamination the workshop

environment. Always fill the tank with powder in such a way that the mixture of powder and air does not come out of the tank lid during fluidizing operations. If the amount of powder inside the tank or the air pressure of fluidization is not suitable, the fluidization operation is not done properly and the powder suction towards the injector is so-called spitting. If the fluidized air pressure is high, the cloud of powder created inside the tank will not allow you to see the surface of the powder. If the fluidizing air pressure is too low, small bubbles will be formed in different places on the powder surface and the powder surface will appear completely still. If the fluidize pressure is too low, the speed of the powder flow in the powder pipe will decrease and the paint suction by the injector fails .The air used for fluidizing the powder should be clean and dry. If the compressed air contains moisture, oil or other impurities, over time these polluting substances will fill the pores of the fluidize plate and the plate should be replaced. To avoid this problem, a filter has been installed at the beginning of the air inlet to the device, which prevents impurities from entering the air flow of the system.

How to connect the components

Firstly, the method of setting up the pneumatic and electrical parts of the device and the correct way of connections are explained. The system is fully assembled and packaged, and by connecting the pneumatic and electrical connections, it is ready for use.

- Pneumatic connections

All the pneumatic connections are done according to picture 8. By referring to the back of the unit, the outputs of each of the different components of the system can be seen.

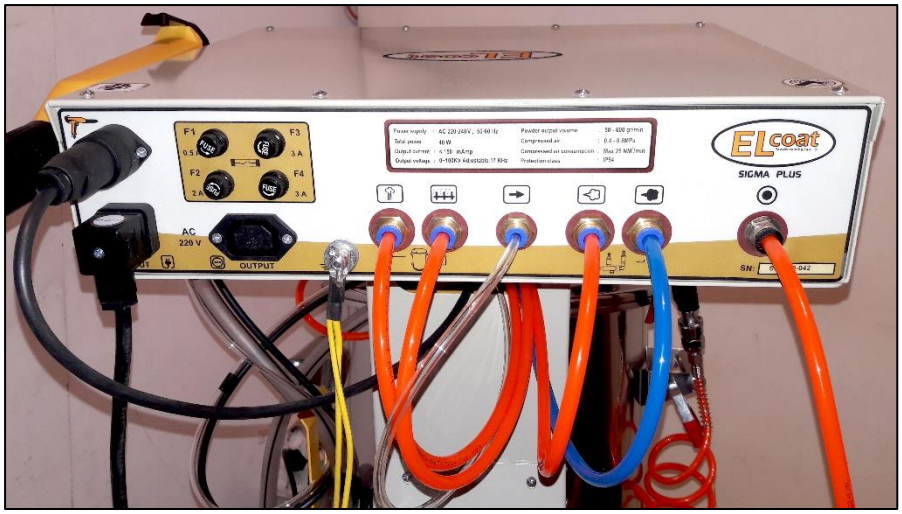

Photo 8. Back panel Pneumatic connections

First, according to picture 9, the the main air hose, after leaving the protective filter installed on the metal base of the powder spraying machine, is divided into two parts, one hose for the cleaning air gun and one hose with a diameter of 8 mm to the entry point. The main air enters the back of the control panel.

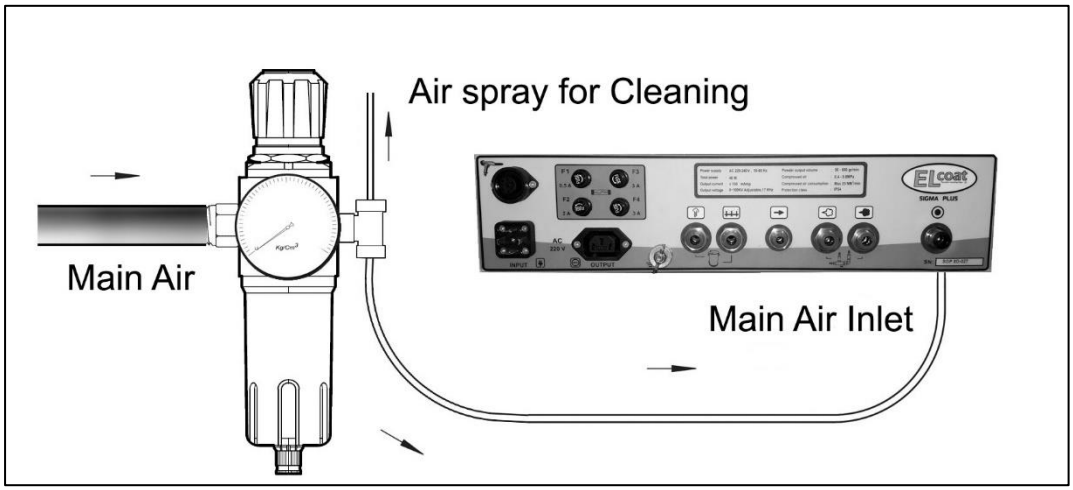

Photo 9. Main Air coonections

Two hoses with a diameter of 8 mm (according to picture 10) are connected to the two injector outlets at the back of control unit. The other end of the hoses is connected to the injector exactly as shown in picture 10. The air hose for cleaning the gun head is also connected to the end of the gun with a diameter of 6 mm.

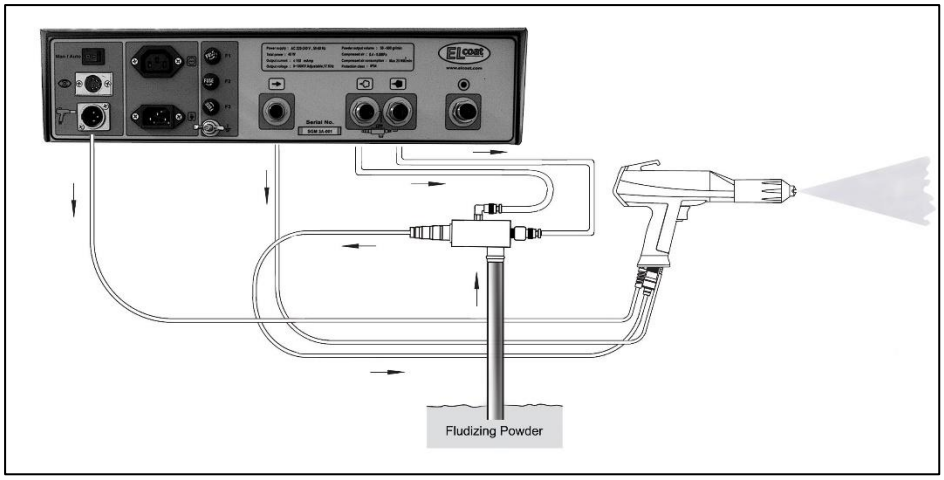

Photo 10. Spray gun, Powder injector and control panel connections

The fluidizing outlet on the back of the control panel is connected to the fitting at the bottom of the tank by another hose with a diameter of 8 mm to adjust the fluidizing pressure.

- Electrical connections

According to picture 8, first install the earth wire and then connect the power cable. Finally, install the gun socket. To protect the electric circuit, there is a 0.5 amp fuse, a 2 amp fuse and two 3 amp fuses in the circuit, which will cut the circuit fuse in case of current unstability and help the safety of the system.

Operating

Before turning on the device, check the connection of hoses and cables, including the earth wire attached to the device. Turn on the air compressor and ensure that the oil and water in the air are drained from the compressor. Turn on the device and control the air flow through the relevant regulator. The minimum required air is 6 bar. Hold the gun towards the cabin and press the trigger. In this case, the voltage is zero or close to zero to prevent the powder from being absorbed to you. When the air enters the system, the fluidization operation starts and the dust caused by fludization of the powder is directed out through the hose on the tank.

Photo 11. Turning on the system

By pressing the gun trigger, the system circuit, including the electronic and pneumatic parts, is activated, and the electronic part sends the spray command based on the settings made. Adjust the air pressure with the help of the regulator installed on the outlet of air filter

Photo 12. Adjusting the amount of spraying, flow and voltage

According to picture 12, turn the air controller clockwise to adjust the amount of powder output. If the powder comes out irregularly from the gun, by turning and adjusting the volume of the auxiliary air control in the clockwise direction, regularize the spread of the powder and create a complete cloud to prevent the accumulation of powder at the nozzle head. Adjust the amount of powder fluidization with the corresponding regulator. After setting all the parameters, adjust the voltage to the desired level. Also there are two voltage and current volumes on the front panel. Flow volume

is used to overcome the Faraday cage phenomenon in corners and for double painted surfaces.

- **Color Change**

Injector cleaning

The injector, which feeds the powder through the powder tank and directs the powder to the head of the gun, should be checked and cleaned according to a regular schedule.The hose fitting used in the injector is subjected to corrosion and erosion due to the continuous passage of powder. If the faulty and worn out hose fitting is not replaced at the right time, the powder flow will be reduced and the powder will spit. If this continues, it leads to reducing the speed of spraying, the quality of spraying will also decrease and the entry of fine particles separated from the hose fitting into the paint will cause poor quality of the coating.

To change the color, the operation steps are the same as the work termination steps. First,turn off the device and close the air inlet valve. Then, disconnect the air mover hose connected to the tank (picture 13)

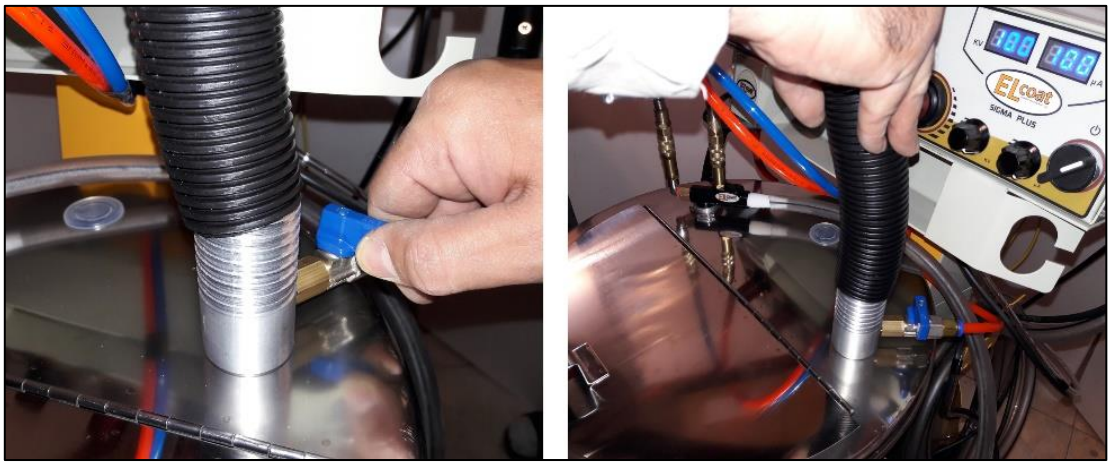

Photo 13. Air mover connection to powder tank

Photo 14. Cleaning the Powder Injector

Disconnect the injector connections, hoses amd hose fitting. Remove the injector from its place. Remove the powder tube. After removing the injector from the tank, clean it completely with air. (Picture 14)

Clean the powder tube and powder hose with air. After unloading the paint inside the tank, open the seal between the upper and lower parts of the tank and completely clean the upper surface and the fluidize plate. Since the fluidize plate is very vulnerable, avoid hitting it or cleaning it with water or any solvent. Put the injector hose fitting in its place. Put the injector and the powder tube in place and connect all hoses.

Gun Cleaning

At the end of each work shift or color change, the parts of the spray gun must be completely dismantled and cleaned. According to picture 15, first, open the threaded sleeve holding the spray nozzle. The spray nozzle is released from its place. Then clean the passage of the powder. Clean the spray nozzle and its accessories with air. After cleaning all parts of the gun, to start working again, first put the nozzle in its place. Then tighten the nozzle threaded sleeve in place. Place the deflector in its place. Place the deflector in such a way that it passes through the O-ring installed on the nozzle so that it is completely and firmly in place. Also, it is necessary to completely clean the powder hose with air.

Photo 15. Cleaning the Spray Gun

Spare Parts

To order spare parts, write down the necessary parts from the pictures below and inform the manufacturer

Photo 16. Sigma Plus Spray Gun Spare parts

No	Item name	No	Item name
1	Manual gun shell	8	Gun trigger
2	Cascade	9	Cleaning Air hose connection
3	Round Nozzles	10	Powder hose connection
4	Treaded Sleeve	11	Gun socket
5	Small deflector	12	Gun plastic spring
6	Gun microswitch	13	Grounding plate
7	Gun trigger holder	14	Gun back cover

Photo 17. Powder Injector parts

No.	Item Name
1	Powder Injector
2	Hose fitting

Powder Coating Troubleshooting

POWDER COATING

TROUBLE SHOOTING GUIDE

PROBLEM Poor attraction of powder the component	
CAUSE	**SOLUTION**
Incorrect voltage at the gun	Check voltage, clean or replace gun
Poor earthing	Clean grounding points & hangers
Excessive build up of cured powder coating on hangers	Clean hangers
Moisture in spray booth	Check booth air supply for quality
Gun air pressure too high	Reduce forward air pressure
Incorrectly positioned guns	Reposition offending guns
Poor hanger design	Re-design hangers to reduce shielding

PROBLEM Poor penetration	
CAUSE	**SOLUTION**
Too low powder delivery	Increase powder flow
Poor grounding	Check & improve grounding
Incorrect spray pattern	Try different spray nozzles
Too high voltage	Reduce voltage so that surfaces closest to the gun do not repel powder
Incorrect powder delivery velocity	Reduce air setting so powder air stream does not blow powder away
Poor gun placement	Adjust gun position to enter more directly into recessed area
Powder too fine	Reduce ratio of reclaim to hopper OR Check particle size distribution

PROBLEM Film thickness on component too low	
CAUSE	**SOLUTION**
Powder delivery rate insufficient	Set correct powder flow pressure OR Check if venturi is the right size, clean and set correctly
Insufficient coating time	Increase coating time of component by slowing the conveyor speed OR Increase voltage and forward air flow, reposition guns
Faraday cage effect	Adjust voltage and forward air flow, reposition guns
Surface area of hanger too large compared to the surface area of the workpiece	Reduce the size of hangers
Damp powder	Remove powder and replace, ensure powders are sealed and stored in the correct manner

PROBLEM Appearance looks uneven and broken before curing	
CAUSE	**SOLUTION**
Back ionisation	Reduce Voltage OR Check if earthing points are clean OR Reduce deposition rate and film thickness OR Ensure no moisture is entering the system OR Move gun further away from component OR Check for build up of metallic particles within the gun and components, clean if necessary

PROBLEM Film thickness on component to high	
CAUSE	**SOLUTION**
Excessive powder delivery	Reduce powder feed to gun OR Increase distance between gun and component
Gun voltage to high	Reset gun voltage
Ecessive coating duration	Reduce time of component in front of the gun by: Increasing the conveyor speed OR Increase the reciprocator speed

PROBLEM Surging and spitting	
CAUSE	**SOLUTION**
Damp air supply	Check air drier OR Install refrigeration unit OR Empty water taps
Varying air supply	Possible compressor overload
Damp powder	Remove powder, full plant clean down, start again with new powder. Ensure any remaining powder is resealed securely until re-use
Powder too fine	Check ratio of recovered powder to virgin powder is correct. Alter if required

RECOVERY

PROBLEM Poor containment of powder booth	
CAUSE	**SOLUTION**
Primary air-filters blocked or damaged	Clean or replace filters OR Check reverse air cleaning system OR Check compressed air for quality
Secondary air-filters overloaded due to damage of main filters	Inspect and replace bag filters OR Clean or replace cartridges
Spray booth opening too large	Reduction of opening
Improper gun position	Re-align spray gun
Powder delivery too high	Reduce number of spray guns

PROBLEM Contamination of surface of work-piece	
CAUSE	**SOLUTION**
Powder or foreign particles falling from conveyor or hangers	Clean conveyor regularly and strip hangers /hooks
Contamination through reclaim powder, damage to the in-line sieve	Replace torn sieve
Contamination through foreign bodies from work floor entering booth	Clean work floor and improve house keeping
Contamination through compressed air supply	Check compressed air for quality

PROBLEM Contamination by recycled powder	
CAUSE	**SOLUTION**
Ineffective cleaning of recovery and recycle system	Complete clean down of system

PROBLEM Powder recovery below specified rate	
CAUSE	**SOLUTION**
Air velocity too low	Compare air flow with specification
Powder too fine	Check PSD of powder , contact the powder manufacturer

CURING

PROBLEM Gloss too high	
CAUSE	**SOLUTION**
Cure temperature too low	Increase air temperature and metal temperature OR Decrease track line speed
Oven cycle too short	Decrease track line speed OR Increase oven temperature OR Extend cure time (box oven)

PROBLEM Gloss too low	
CAUSE	**SOLUTION**
Oven temperature too high	Reduce air temperature and check metal temp OR Increase line speed
Time in the oven too long	Increase line speed OR Decrease oven temp
Contamination with a powder which is incompatible	Clean all equipment including guns, booth and recovery system and re-charge with virgin powder
Contamination with solven which may contain chlorinated hydrocarbons	Check proximity of vapour degreasing plant; restrict air movement to the powder coating application area

PROBLEM Poor flow	
CAUSE	**SOLUTION**
Heat up rate of the metal too slow	Increase the temperature at the first stage of the oven

PROBLEM Poor hammer or texture development	
CAUSE	**SOLUTION**
Heat up rate too slow	Increase the temperature at the first stage of the oven
Too much reclaim	Reduce the amount of reclaim with the addition of virgin powder

PROBLEM Poor flow	
CAUSE	**SOLUTION**
Heat up rate of the metal too slow	Increase the temperature at the first stage of the oven

PROBLEM Poor adhesion	
CAUSE	**SOLUTION**
Under cure film	Increase oven temperature OR Decrease line speed
Poor pretreatment	Check pre-treatment, adjusting tanks in line with supplier recommendation.

PROBLEM Even discoloration	
CAUSE	**SOLUTION**
Cure temperature too high	Reduce oven temperature ,or increase line speed

PROBLEM Patchy discolouration	
CAUSE	**SOLUTION**
Inadequate pre-treatments	a.Check eveness of pre-treatment b.Check and adjust chemical balance of pre-treatment c.Check final rinse water and drying
Corrosion products on the metal surface	Inadequate clean off with chemical pre-treatments OR Check final rinse for contamination
Powder contamination	Check cleanliness of plant and recycling system

POWDER SUPPLY

PROBLEM Poor fluidisation in powder hopper	
CAUSE	**SOLUTION**
Powder level too low	Add powder to the normal level
Compact or damp powder	Manually loosen powder in hopper OR Check compressed air for quality
Partly plugged membrane	Check bottom of hopper and membrane for any obstruction
Powder particle size	Decrease the amount of reclaim to the hopper OR Check PSD of virgin powder

PROBLEM Blocked hoses powder pump or venturi	
CAUSE	**SOLUTION**
Normal build up	Clean or replace parts
Too high air pressure	Reduced air pressure on pump and gun
Air supply moist	Check air supply for quality
Material choice of hose	Check hoses for material quality
Powder hoses too long	Modify layout or shorten hose
Worn venturi or pump	Replace worn parts
Too fine powder	Decrease amount of reclaim powder to hopper OR Check PSD of virgin powder

PROBLEM Powder dusting out of hopper	
CAUSE	**SOLUTION**
Too high air pressure	Reduce air pressure too the fluid bed
Too fine powder	Decrease amount of reclaim to hopper OR Check PSD of virgin powder

CONTAMINATION

PROBLEM Foreign matter in film	
CAUSE	**SOLUTION**
Inadequate cleaning	Check or adjust flow rate, spray nozzle position and temp in each pre-treatment stage OR Check or adjust operating specs for chemicals OR Clean guns booths and recovery systems
Powder is too course or not sieved	Sieve all reclaim powder, check for holes in sieve,check or change sieve mesh size
Virgin powder is bitty	Talk to your lab

PROBLEM Chemical cross-contamination	
CAUSE	**SOLUTION**
Improper loading or spacing of parts	Check and adjust parts for maximum drainage OR Check and adjust drain time between stages

PROBLEM Contamination of colour	
CAUSE	**SOLUTION**
Poor housekeeping when colour changing	Totally clean plant,gun and recycling equipment and recharge with new powder
Cross contamination from manufacturer	Contact lab

PROBLEM Pinholes in the film	
CAUSE	**SOLUTION**
Silicone contamination	Locate and remove source
Oil contamination	Check degreasing plant
Oil/water in the air supply	Check oil/water seperators on the air supply

ELcoat
Powder coating Equ. ®

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