

User's Guide Manual

ELCOAT POWDER COATING SYSTEM

Sigma PLUS Serie

Including troubleshooting



A Message from ELCOAT

Welcome to ELCOAT family. We extend our sincere thanks for your purchase of the Sigma Plus powder coating system.

To ensure safe, efficient, and optimal performance, we strongly recommend that you thoroughly review this user manual prior to operation. The manual provides comprehensive operational guidance through clear, step-by-step instructions designed to facilitate correct system use.

This document is intended to serve as your primary resource for proper system operation, enabling smooth coating processes, and includes a troubleshooting section to help address common issues and minimize operational downtime.

While this manual has been prepared with utmost care to ensure accuracy, ELCOAT reserves the right to implement technical modifications and product improvements at any time without prior notice.

The contents of this manual are proprietary. No part may be reproduced, distributed, or utilized for commercial or scientific purposes without the express written consent of ELCOAT.

Please note that the official warranty period commences upon delivery and successful initial commissioning of the powder coating system.

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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, Powder Booth, Conveyor system, Powder 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

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.

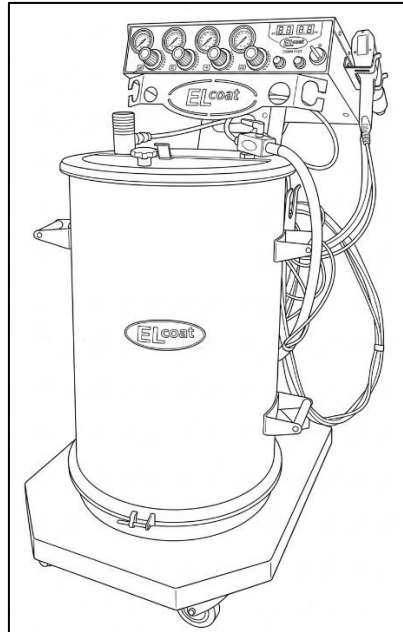


Photo 1. Sigma Plus Powder Coating Machine

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 m³/hr.

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 gr/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: pneumatic control system (which controls air pressure) and 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: is 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.

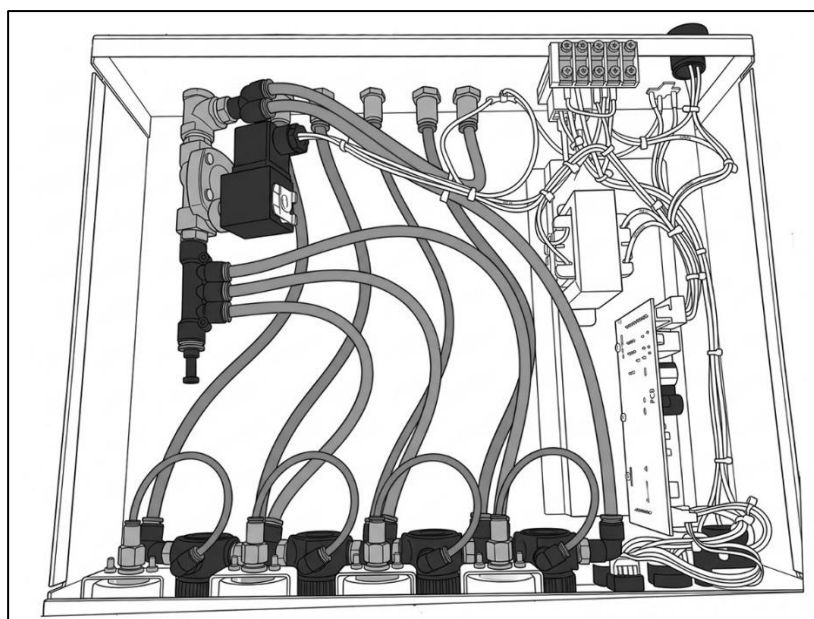


Photo 2. Sigma Plus Control Panel inner view

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 current flow rate. Now, the components of the control panel (front and back view) are introduced.

Control Panel Front view

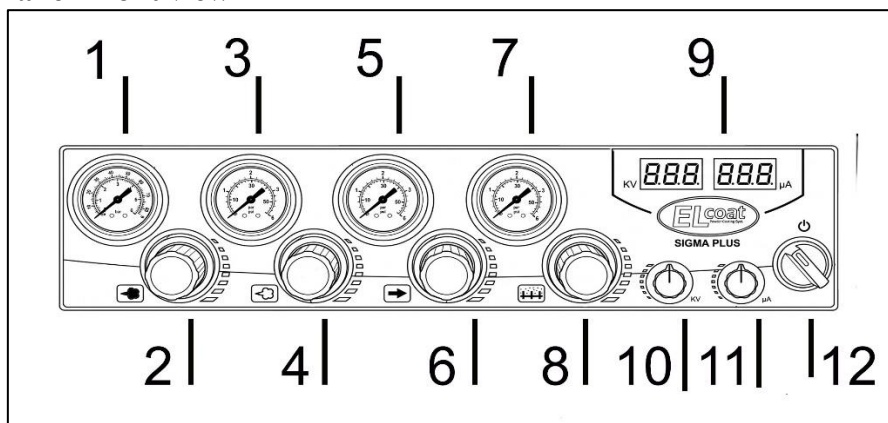


Photo3. Control Panel Front view

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

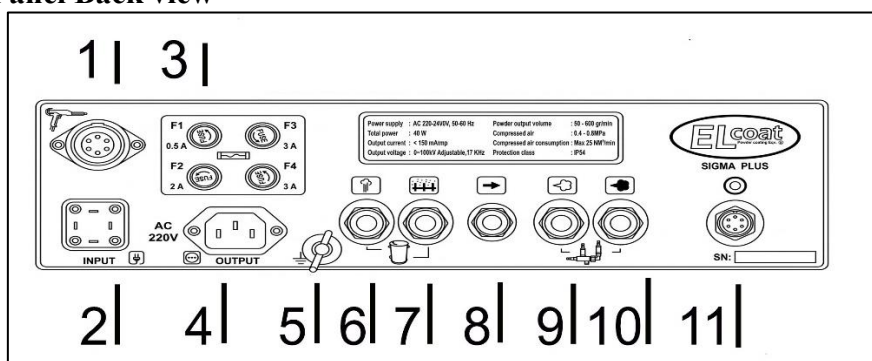


Photo 4. Control Panel Back view

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 which are connected to the injector head.

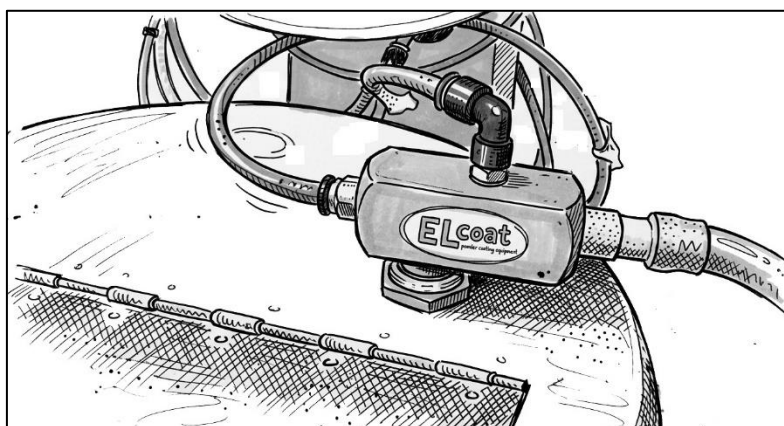


Photo 5. Injector Pump and hoses connections

Based on photo 5, the injector has three inputs and one output.

The three inputs are:

A hose for the main air supply.

A hose for the auxiliary air supply. A tube that carries powder from inside the tank. The single output is a hose connected to the spray gun.

Here's how it works:

Main Air: Creates suction inside the injector, which pulls powder from the tank into the system. **Auxiliary Air:** Pushes the powder that has been sucked in through the output hose toward the gun. Together, these two air streams mix with the powder inside the injector. By adjusting their pressures, the operator can control the powder cloud that forms at the tip of the gun. For the system to spray correctly, all three pneumatic settings—fluidizing air (inside the tank), auxiliary air, and main air—must be adjusted properly. If any one is set incorrectly, the spraying process will not work as intended.

➤ 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.

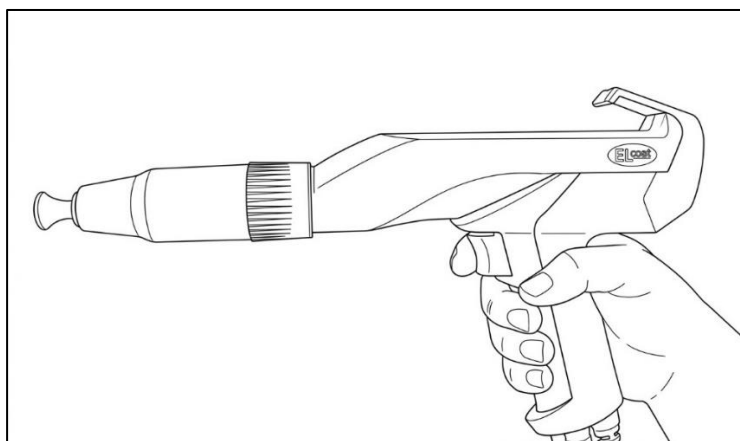


Photo 6. Sigma Plus Spray Gun

➤ Powder container and fluidization system.

To enable proper powder spraying, a specialized tank is needed. This tank uses a porous plate at the bottom, called a fluidizing plate. Air flows up through this plate, causing the powder paint to behave like a fluid. This fluidized state is essential for the system to suck the powder out of the tank consistently and spray it correctly.

In ELCOAT system, the powder tank has a small door on top. This design allows the operator to easily check and manage two key things while the system is running:

1. **Powder Level:** To see how much powder is left in the tank.
2. **Fluidization Quality:** To observe if the powder is “boiling” or fluidizing properly.

The operator can do this without powder escaping, and can add more powder through this door when needed.



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.

What is Fluidizing?

Fluidizing is the process of mixing compressed air with powder inside the tank. This air, which enters from the bottom and passes up through a special porous plate (the fluidizing plate), separates the powder particles and makes the powder behave like a liquid. A key benefit is that it reduces the powder's moisture content.

How to Identify Proper Fluidization

When done correctly, the powder should look like gently boiling water. The air pressure must be set carefully to achieve this state without causing powder to escape from the tank, which leads to waste and contaminates the workshop.

Important Setup Rule

Always fill the tank so that when the air is on, the powder-and-air mixture does not puff out from under the tank lid.

Problems from Incorrect Setup

If the powder level or fluidizing air pressure is wrong, the process will fail:

Poor Suction (“Spitting”): The powder won’t flow smoothly to the injector and will spit or pulse instead.

Pressure Too High: A dense powder cloud will form inside the tank, blocking your view of the powder surface.

Pressure Too Low: You will only see small, still bubbles on an otherwise motionless powder surface. This also slows the powder flow in the supply tube, causing the injector to fail.

Air Quality Requirement

The compressed air used for fluidizing must be clean and dry. Moisture, oil, or other impurities will clog the tiny pores of the fluidizing plate over time, requiring its replacement.

Preventive Maintenance

To avoid this, a filter is installed at the system’s air inlet to remove impurities before they can enter and damage the fluidizing plate.

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 photo 8. By referring to the back of the unit, the outputs of each of the different components of the system can be seen.

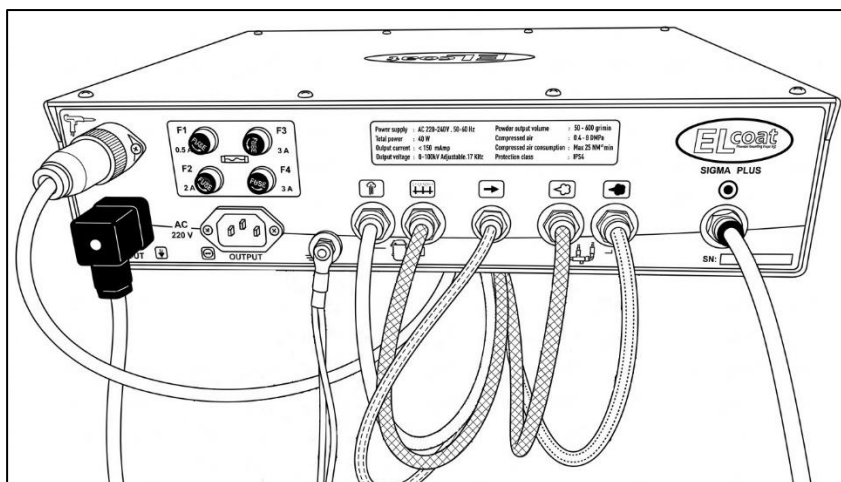


Photo 8. Back panel Pneumatic connections

First, according to photo 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.

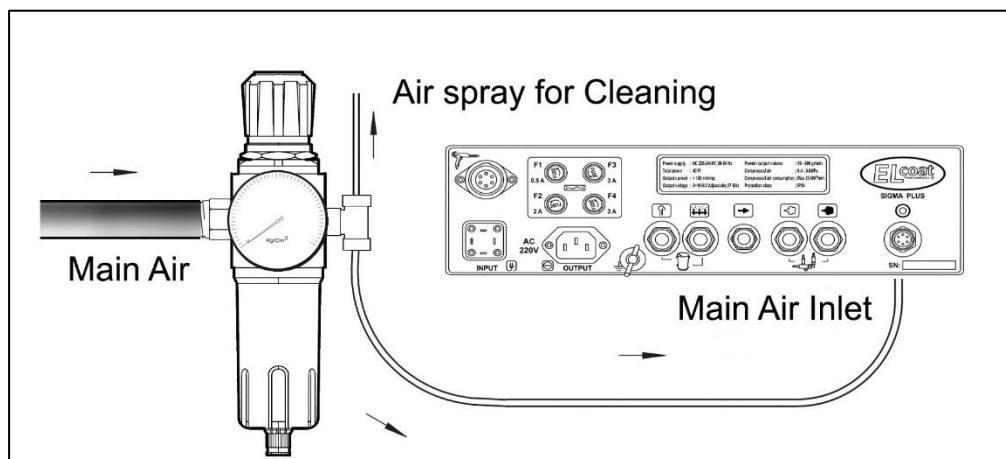


Photo 9. Main Air connections

Two hoses with a diameter of 8 mm (according to photo 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 photo 10. The air hose for cleaning the gun head is also connected to the end of the gun with a diameter of 6 mm.

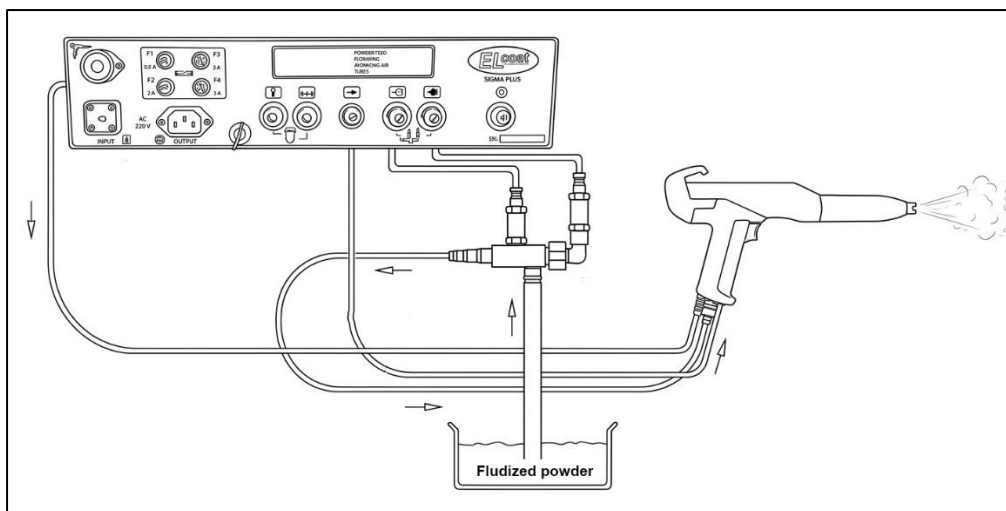


Photo 10. Spray gun, Powder injector and control panel connections

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 photo 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 instability and help the safety of the system.

Operating

Before starting the machine, perform these safety and setup checks:

Inspect Connections: Ensure all hoses, cables, and the equipment grounding (earth) wire are securely connected.

Prepare the Air Supply: Turn on the air compressor. Drain any accumulated oil and water from the compressor's tank to ensure clean, dry air.

Start the System: Turn on the powder coating machine. Using the pressure regulator, adjust the main air supply. The system requires a minimum of 6 bar of pressure.

Perform a Safe Test Spray:

Point the spray gun into the spray booth. Make sure the gun's high-voltage output is turned off or set to zero to prevent the powder from being attracted back to you. Press the trigger. You should hear air flow, and the powder inside the tank will begin to "fluidize. Any excess dust from this process will be vented safely out of the tank through its exhaust hose.

This procedure verifies that your system is properly connected, has clean air, and is functioning safely before you begin coating with high voltage.

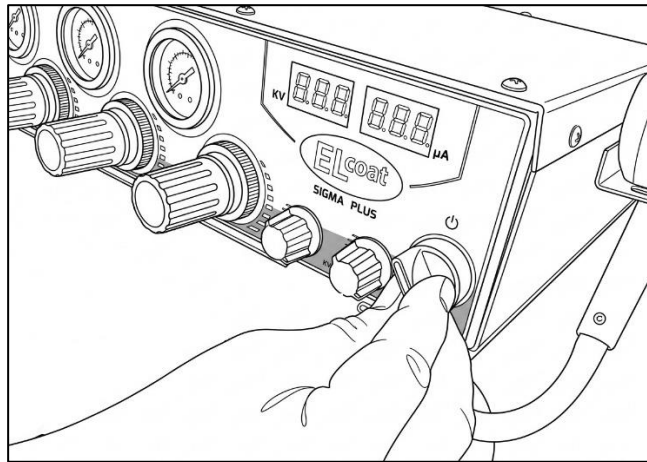


Photo 11. Turning on the system

To start spraying, simply pull the gun's trigger. This activates the entire system—both the electronic controls and the air supply.

The electronics then activate the powder flow based on your preset adjustments.

You can adjust the air pressure using the regulators.

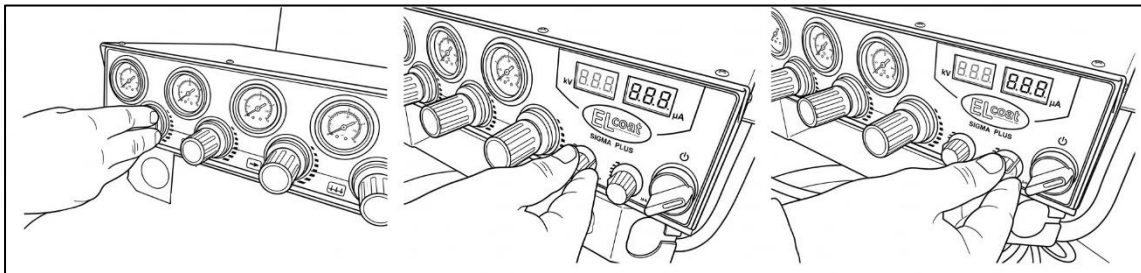


Photo 12. Adjusting the amount of spraying, flow and voltage

Refer to photo 12, To adjust the amount of powder coming out of the gun, turn the main air controller clockwise. If the powder flow is uneven or patchy, turn the auxiliary air control clockwise to smooth it out. This helps create a full, even powder cloud and prevents clogging at the nozzle.

Use the fluidizing air control to adjust how well the powder is aerated inside the tank. Once all the air settings are correct, set the voltage to the level you need.

The control panel also has displays for voltage and current. Use the current adjustment to help the powder reach into corners and coat recessed areas—this overcomes the “Faraday cage” effect—and is also useful for applying a second coat.

➤ 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 (photo 13)

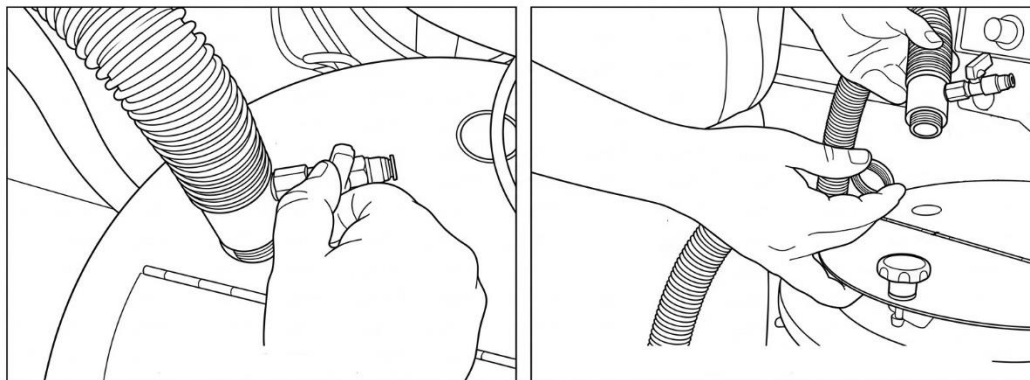


Photo 13. Air mover connection to powder tank

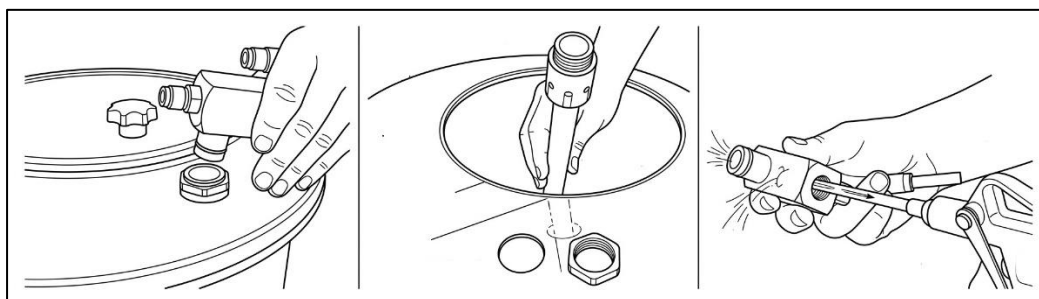


Photo 14. Cleaning the Powder Injector

Disconnect the injector connections, hoses and hose fitting. Remove the injector from its place. Remove the powder tube. After removing the injector from the tank, clean it completely with air. (Photo 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 photo 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.

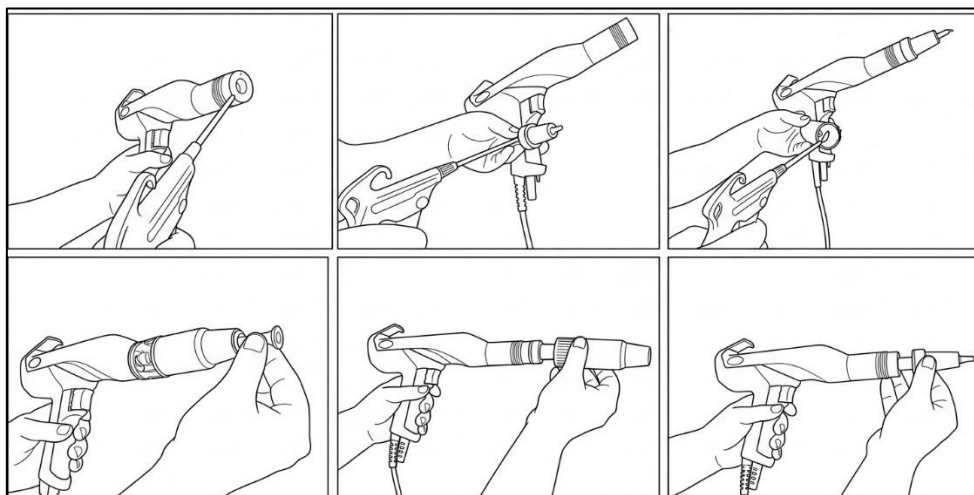


Photo 15. Cleaning the Spray Gun

➤ Spare Parts

Gun spare parts are seen in photo 16.

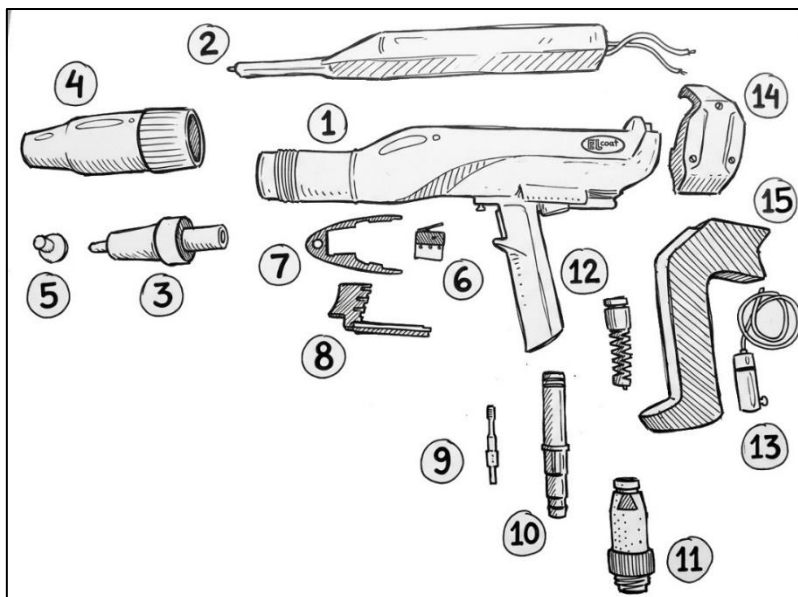


Photo 16. Sigma Plus Spray Gun Spare parts

No	Item name	No	Item name	No	Item name
1	Manual gun shell	6	Gun microswitch	11	Gun socket
2	Cascade	7	Gun trigger holder	12	Gun plastic spring
3	Round Nozzles	8	Gun trigger	13	Grounding
4	Treaded Sleeve	9	Cleaning Air hose connection	14	Gun back cover
5	Small deflector	10	Powder hose connection	15	Gun holding cover

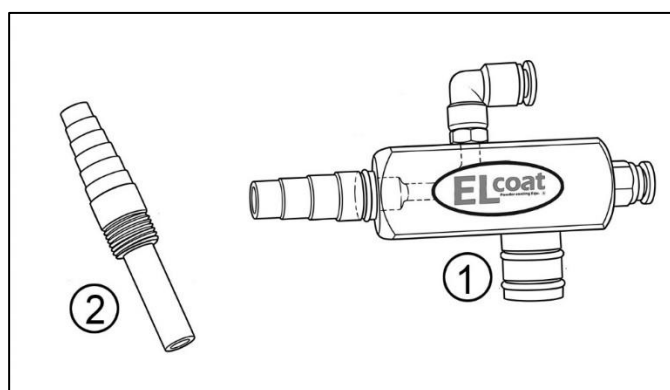


Photo 17. Powder Injector parts

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 too high	
CAUSE	SOLUTION
Excessive powder delivery	Reduce powder feed to gun OR Increase distance between gun and component
Gun voltage too high	Reset gun voltage
Excessive 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 traps
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 evenness 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 coarse 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



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