

Verband der deutschen Lackindustrie e.V.

Check list

**for an unproblematic application
of powder coating materials**

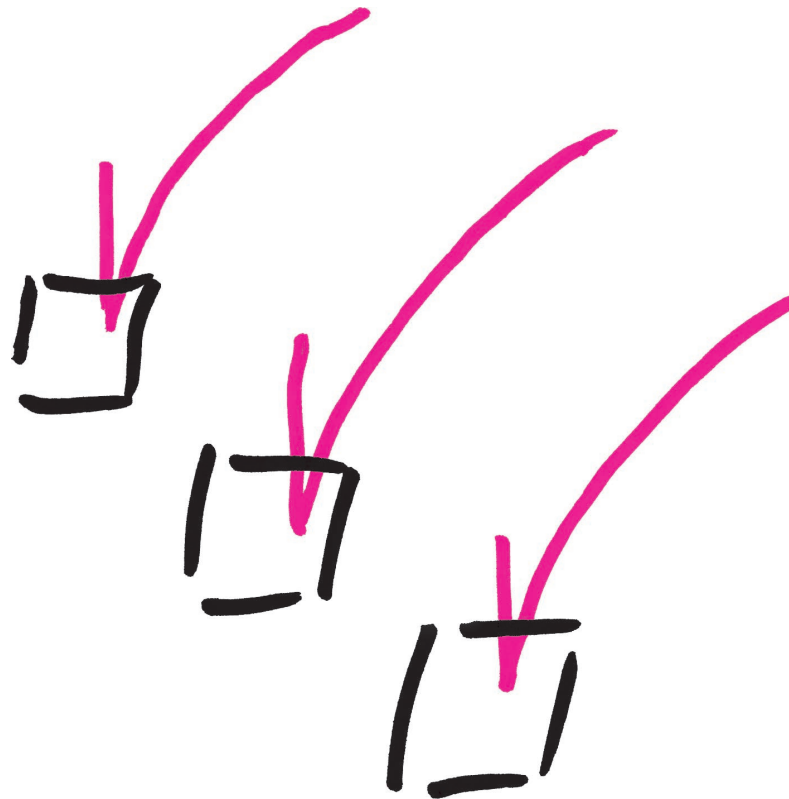


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1. Field of application

This VdL-check list for the application of powder coating materials without problems is intended to facilitate the work of the operator of a powder coating plant, in order to list and recognize the most frequent problems, to find out possible reasons and to provide for remedies.

The coating material is applied to a substrate by electrostatic spraying. For the purpose of this VdL-check list, application of powder coating materials is to be understood as application of those powder coating materials which have been manufactured almost exclusively by using "duroplastic" binders.

2. Profiles of requirements for the formation of a powder coating free from problems

The quality of the powder coating obtained mainly depends on the fact that the following two requirements are fulfilled. One requirement is that the components of the plant permanently work in an optimum manner, and the other that the profile of requirements of the powder coating material is complied with. If both requirements are fulfilled, problems during the application can be avoided.

As a part of a quality assurance system, the function of the components of the plant is to be verified by reliable maintenance. Instructions for maintenance of the components will be provided by the manufacturers and suppliers of plants (see operating instructions). In the instructions for maintenance the following recommendable maintenance work should be specified in any case:

Daily maintenance work:

- Blowing out of spray guns and checking for sintering
- Checking the adjustment of the guns
- Checking the working pressure of the guns
- Checking injectors (sintering, wear by grinding)
- Blowing out injectors and hoses
- Cleaning the plant, recovery unit and vicinity
- Checking the suction resistance of the recovery unit

Weekly maintenance work:

- Checking the earthing control
- Checking the pressurized air (clean, dry, free from oil)
- Checking guns and voltage
- Checking powder hoses for sintering and kinks
- Checking stroke movements / checking reciprocators adjustments
- Checking filters, sieves

Information on additional maintenance work is to be taken from the maintenance instruction or other documents provided by the manufacturer. Regular maintenance work is the precondition for an application without problems.

By this, stoppage times and service work of the plant suppliers can be minimized.

If there should be problems the reason of which cannot be recognized, the respective service department of the plant supplier is to be requested for advice.

The profile of requirements of the powder coating material is to be harmonized with the manufacturer of the material as a part of a quality assurance system. As parts of the profile of requirements which influences the behavior of deposition, circulation and film formation, in the first line the following properties to be tested belong:

Particle size distribution, density, melting behavior, resistance to blocking, composition, moisture content, suitability for fluidization, flow ability, gel time and stoving conditions.

Problems, which can be referred back to the properties of the powder coating material, should be notified to the field service of the manufacturer of the material so that suitable remedy measures can be taken.

3. Problems during application

Problem	Recognition	Possible reason	Remedy
<i>Fluidization</i>	Interrupted or no feeding from the gun	Insufficient air for fluidization; bottom of container tamped	Raising the air pressure; checking the bottom
	Visually perceptible local bubbles and formation of craters in the fluidization container	Pressurized air too humid, oil-containing; humid powder; relative humidity of the air at the place of powder application	Checking the function of the refrigerating drier for the air; checking the water-oil separator
Poor flow ability in the powder circulation		Bottom of container tamped or damaged	Cleaning or exchange of the bottom
		Air temperature in the coating plants too high	Storage conditions of the powder manufacturer to be observed
		„Lumps“ in the fluidized powder	Additional vibration of the powder container
		Powder in the circulation too fine; circulation function disturbed	New powder to be metered continuously and automatically
		Insufficient degree of deposition	Providing for appropriate circulation (recovery, filter)

Problem	Recognition	Possible reason	Remedy
<i>Deposition, sintering in hoses, in injectors</i>	Irregular powder output from the gun (intermittently, Pulverbatzer, Pulverspucker)	Air velocity too high; powder output too high	Reducing the air velocity; Distributing the powder output to more guns;
		Wrong gun attachment	Using suitable guns or gun attachments
<i>Deposition, sintering in, on spraying devices (rebound discs, nozzles)</i>		Hoses unsuitable (hose material, laying, dimensions)	Using suitable hoses, Observing hose laying and length of hoses
		Mechanically damaged or worn parts	Cleaning injectors, rebound discs and nozzles so that the surfaces will not be roughened or damaged
		Powder in the circulation too fine; metering of new powder into the circulation insufficient	New powder to be metered continuously and automatically
		Too much humidity in the powder	Checking the functions of the refrigerating drier and the water-oil separator
		Pressure of the air for feeding too high	Reducing the pressure of the air
		Pressure variations in the pressurized air network	Checking the pressurized air network

Problem	Recognition	Possible reason	Remedy
<i>Irregular film thickness distribution on the object</i>	Color changes caused by opacity differences (formation of stripes) of the powder layer	Irregular powder feeding, no optimum distance between gun and object	Optimizing plant parameters
	Surface does not appear uniform	No optimum relation of the belt speed to the stroke speed of the guns; Variations of the high voltage	
		No optimum particle size distribution	Optimizing the particle size distribution
		Strong variation of the powder column on the Venturi jet	Providing for uniform metering to the fluidization container
		Object design (Faraday cage) and/or suspension unfavorable	Changing object design and/or suspension
		Pressure of the air for feeding too high; powder layer will be blown off due to the air velocity being too high	Reducing feeding pressure

Problem	Recognition	Possible reason	Remedy
<i>Insufficient adhesion of the powder (powder flows down) on the flat object</i>	Color changes caused by opacity differences of the powder layer; Surface does not appear uniform	Objects insufficiently earthed; field strength too high	Optimizing plant parameters, cleaning of the suspension gears
		No optimum adjustment of the air for metering and pulverization	Changing voltage and distance of guns to the object
		Voltage too high	Reducing the voltage
		Powder output too high	Reducing the powder output
		No optimum particle size distribution	Optimizing the particle size distribution
<i>On objects with corners and recesses (powder will be blown off)</i>	Parts of the area of the object remain uncoated	Material of hoses unsuitable	Using suitable hose material;
		Wrong gun attachment	Using the appropriate gun attachment
		Feeding speed in the gun too high	Reducing the velocity of the air for feeding
		Geometry of the object or suspension less favorable for coating	Changing object design and/or suspension
<i>In case of TRIBOelectric application</i>	as above	Insufficient charge due to - powder through-put too high - wrong particle distribution - worn rebound bodies in the gun	Permanent measurement of the conductance current and, respectively, of the TRIBO electric charge of the powder

Problem	Recognition	Possible reason	Remedy
<i>Film formation on edges</i>	Distinct formation of rolls on corners and edges of the objects	Powder cloud too large	Changing the powder cloud systematically
		Distances between the objects too large (shield edges)	Excluding powder feeding between the gaps (apply gap control)
		Content of coarse particles in the powder too high	Optimizing particle distribution
<i>Frame effect</i>	Surface does not appear uniform, area of edges differs	Deposition behavior on the surface of the objects different	Using suitable guns or gun attachments
		Powder output too high, voltage too high	Reducing feeding pressure and high voltage
		Distance of the guns from the object unfavorable	Contacting the plant manufacturer or supplier
<i>Sudden release of powder from the spray booth</i>	Powder dust escapes from the booth and contaminates the vicinity	Most frequent reasons are draughts in the plants hall due to open doors and windows	Closing windows and doors
		Filter material in the recovery unit "obstructed"	Checking the filter under-pressure

Problem	Recognition	Possible reason	Remedy
<i>Discharges</i>	Sparking	Insufficient conductivity of the hose material	Using hoses recommended by the plant supplier
		Insufficient earthing of injector	Taking care of injector earthing
		Insufficient earthing of objects	Cleaning of suspension hooks; regular removal of the coating on the suspension gears
		Use of metallic powders	Using suitable gun attachment
	Electric shock with persons	Insufficient earthing of the hand gun	Wearing conductive protective clothing (gloves, shoes)

4. Problems with the coated object

Problem	Recognition	Possible reason	Remedy
<i>Nominal values of mechanical resistance (flexibility, surface hardness)</i>	Profile of requirements of the coating will not comply with (complaint)	Powder not or insufficiently cross-linked	Optimum adjustment of object temperature and waiting time (temperature/time diagram)
		Nominal values of the object temperature and temperature waiting time (stoving conditions will not be achieved)	
<i>Nominal values of resistance to corrosion and chemicals</i>		Heating temperature/heating time too high/too long or too low/too short	
		Insufficient cleaning of the objects (grease, dust, release agent)	Changing the pre-treatment
<i>Adhesion of the intermediate coat in the case of two-layer applications (peeling)</i>		Insufficient pre-treatment of the objects (phosphating, chromating)	Optimizing degreasing and pre-treatment
		Incompatibility of pre-treatment and powder; primer overbaked	Allowing the system to be adjusted
		Unsuitable powder; film thickness extremely high	

Problem	Recognition	Possible reason	Remedy
<i>Leveling (orange peel)</i>	Profile of requirements of the coating will not complied with (nominal value for leveling)	Film thickness of the powder coating too high or too low	Optimizing the feeding speed of the powder
<i>(All areas or parts of the object)</i>		No optimum temperature distribution at the object	Optimizing the object temperature
		Use of unsuitable powder coating material	Using suitable powder coating material
		Unsuitable particle size distribution of the powder coating material	Using powder with modified particle size distribution
		No compatibility with powders of other manufacturers	Careful cleaning of the plant, no mixing of different powders
		Reactivity of the powder too high	
		Back-spray effect (voltage too high, temperature and relative humidity at the location of the plant have changed)	Reducing the film thickness, reducing the voltage; checking the air-conditioning; Removing of "superfluous" electrons by special guns or additional equipment

Problem	Recognition	Possible reason	Remedy
<i>Gloss deviation</i>	Profile of requirements of the coating will not complied with (nominal gloss value)	Stoving conditions have not complied with	Optimizing the stoving conditions
		Special stoving technology (directly gas-heated driers, infrared driers)	Using suitable powders
		Poor leveling (shelf life of the powder expired or stored too warm)	Optimizing the storage conditions, using new powder
		Incompatibility with other powders	Careful cleaning of the plant; no mixing of different powders
		Powder thermally unstable	Using thermally stable powders
		Film thickness too high/too low	Optimizing the film thickness
Emissions from the powder or the substrate during the stoving process	Using suitable powders, checking substrate/pre-treatment		

Problem	Recognition	Possible reason	Remedy
<i>Contaminated surface</i>	Nominal values of surface assessment will not be achieved	No sieving machine available	Using a sieving machine
		Insufficient sieving effect	Using sieves of small mesh size
		Dirt from the air in the plant hall will be deposited at the coated object, due to air streams	Using a sieving machine with several sieves; Using a sieving machine with automatic removal of dirt and residues
		Dirt from the feeding unit	Cleaning of the feeding unit
		Dirt from suspension gears	Using a dirt-removing attachment at the feeding unit
		Emissions from the powder in the oven	Regular cleaning of the oven
		Contaminated air will be sucked into the booth or into the oven	Providing for the separation of the coating plant from other production rooms
		When operating two or more booths: mutual suction of the powder-air mixture (particularly during cleaning)	Providing for separation of space of the booths
		From the final filter very fine powder will be blown into the vicinity	Regular checking of the final filter
		Hose for powder insufficiently cleaned after change of color	Cleaning the hose for powder using pressurized air and plug
		Fibers from clothes will be sucked in through the recovery unit	Using special clothes
		Fibers from the filter of the recovery unit	Using filters that do not lose fibers
		Adhering dirt particles on the object prior to the application	Providing for clean objects prior to the application
		Object has been "cleaned" using clothes being not lint-free	Not using clothes being not lint-free

Problem	Recognition	Possible reason	Remedy
<i>Color deviations</i>	Color of the objects is different	Stoving conditions have changed (temperature of circulating air, temperature–time diagram, overbaking at breaks or feeding stoppage, infrared portion)	Correcting the adjustment of the stoving conditions
		Combustion products in directly gas-heated ovens	Using stabilized powders
		Film thickness beyond the optimum opacity	Optimizing the film thickness
		Object and/or operating conditions has/have changed (dimensions, mass)	Arranging the objects
		Poorly degreased or pre-treated objects	Optimizing degreasing and/or pre-treatment
		Irregular film thickness of a priming coat	Applying the priming coat with uniform film thickness to achieve a substrate of uniform color
		Mixture of two powders	Strictly separating powders; proper cleaning of the plant when changing powders
	Profile of requirements of the powder	Checking or specifying the profile of requirements together with the supplier of the powder	

Problem	Recognition	Possible reason	Remedy
<i>Blisters (closed or opened); „pinholes“</i>	Profile of requirements of the coating will not complied with	No optimum stoving conditions (heating speed)	Optimizing the stoving conditions
	Spots/areas not resistant to stresses	Surfaces of the objects are not properly cleaned (residues of grease, rust, water, emissions from the substrate)	Proper cleaning of the surface of the objects; contacting the manufacturer of the pre-treatment chemicals
		High film thickness (inclusion of air, emissions from the substrate, among others water)	Reducing the film thickness
		Surface of the object has hollow spaces (cracks, cavities, overlaps)	Improving the surface of the objects, changing the design
		Voids in hot-dip galvanized coating surfaces; surface with pores as e.g. in case of die-castings	Annealing the objects
		Profile of requirements of the powder	Using powders suitable for gassing substrates

Problem	Recognition	Possible reason	Remedy
<i>Craters</i>	Profile of requirements of the coating will not complied with	Objects not properly degreased and/or pre-treated	Optimizing degreasing and/or pre-treatment
	Spots/areas not resistant to stresses	Incompatible powder mixtures (contamination)	Separating the powders by very thorough cleaning of the plant
		Influence of products containing silicones	Avoiding silicone-containing products in the application area (checking the air circulation of connected protection areas)
		Voids in surfaces of cast parts, hot-dip galvanized or thermally sprayed coatings; porous substrates such as e. g. die-castings	Annealing the objects Using powders suitable for gassing substrates

Problem	Recognition	Possible reason	Remedy
<i>Runs</i>	Profile of requirements of the coating will not complied with	Film thickness too high or irregular	Optimizing the film thickness distribution
	Quality of fit will not achieved	No optimum stoving conditions (heating rate, object and oven temperatures)	Optimizing the stoving conditions
		Geometry and surface profile of the objects (powder-collecting areas)	Introducing individual coating application for the objects
		Profile of requirements of the powder	

5. Specific problems using metallic powder coatings

Problem	Recognition	Possible reason	Remedy
<i>Poor leveling up to rough surface</i>	Insufficient film thickness up to fine-textured surface	Insufficient deposition	Increasing the high voltage, checking the gun
		Powder output too high	Reducing the powder output
		Insufficient charge in the case of triboelectric application	Using suitable charging (corona outside charging)
<i>Color deviations</i>	„Greying“, no metallic effect	Wrong or different charging procedure, leading to different orientation of the effect pigments	Corona outside application is recommended but in any case the same procedure is always to be used
		Objects will not fit together with regard to color and/or effect	Using powder being stable during circulation; nevertheless to be observed that low quantities of powder be used during circulation and continuously fresh powder be added „not thinking big“
			Using powder “on lost” (costs, disposal!)
		Change of batch for one and the same order	Using the same batch of powder for one and the same order
		Separation in the container of delivery	Using a fluid container to avoid partial separation

Problem	Recognition	Possible reason	Remedy
<i>Still color deviations</i>	Objects do not fit together with regard to color and effect	Color differences between automatic and manual application	If possible choosing no subsequent manual application but previous manual application
		Different substrates	Preparing reference color specimen and limiting color specimens using different substrates
		„Disputes“ with the client regarding the color	Agreement of reference color specimen and limiting color specimens
<i>„Formation of clouds“</i>	Varying light/dark effect on the substrate	Wrong distance of the gun, unequal charging, inaccurate sinus curve, insufficient earthing	Optimizing parameters of the plant
		Very different film thickness	Minimizing film thickness variations
		Automatic application together with subsequent manual application	Choosing previous manual application

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