



Verband der deutschen Lack-
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Information material on powder coatings

Check list for trouble free powder coating

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Contents

1. Scope	3
2. Requirement profiles for a problem free powder coating	3
3. Problems during application	4
3.1 Fluidisation	4
3.2 Deposition, sinter deposits ...in hoses, in injectors	5
3.3 Irregular distribution of film thickness on the object.....	5
3.4 Powder Coating adheres insufficiently.....	6
3.5 During TRIBO applications	6
3.6 Edge design	7
3.7 Electrical discharges	7
4. Problems on the coated object	8
4.1 Insufficient mechanical properties (adhesion, elongation, surface hardness); insufficient corrosion resistance and resistance to chemicals.....	8
4.2 Levelling (orange peel).....	8
4.3 Gloss deviations	9
4.4 Contaminated surfaces.....	9
4.5 Color deviation	10
4.6 Blisters (closed or burst); „pinholes“	10
4.7 Craters	11
4.8 Drop formation	11
5. Specific characteristics when using metallic powders	12
5.1 Insufficient levelling, rough surface	12
5.2 colour deviations.....	12
6. Bibliography	13

1. Scope

The check list for trouble free powder coating was developed by the Technical Committee Powder Coatings, a committee of the German Paint and Printing ink association (VdL).

It is meant to be a tool for the operator of a powder coating plant with injector and pump delivery, to name and detect the most frequent problems, to find possible causes, and to take remedial action.

The coating is applied to the substrate by electrostatic spraying. A powder coating, in the context of this VdL check list, is a coating of powder coating materials. Thermosetting binders are used almost exclusively for the manufacture of these powder coating materials.

2. Requirement profiles for a trouble free powder coating

The quality of the powder coating mostly depends on the requirement of permanent optimal operation of the plant components and the requirement profile of the powder. Problems with the coating process can be avoided if both requirements are respected.

In the context of a quality assurance system the modes of operation of plant components are to be tested by a reliable maintenance. Maintenance directions of the components are provided by the manufacturers of the plant or the respective contractors (see instruction manual). The following recommended maintenance work should necessarily be included in the maintenance directions:

Daily maintenance:

- air-clean the spraying elements and check for sinter deposits
- check adjustments of spraying elements
- check deliver pressure of spraying elements
- check injectors (sinter deposits, grinding)
- air-clean injectors and hoses
- check pumps in plants with pump delivery
- clean plant, recovery unit, and surroundings
- check extraction resistance of the recovery unit

Weekly maintenance:

- check earthing control
- check pressurized air (clean, dry, oil-free)
- check spraying components and voltage supply
- check powder hoses for sinter deposits and kinks
- check stroke movement
- check filters, sieves

Further maintenance work is indicated in the maintenance directions, or the information given by the manufacturer. Maintenance operations executed on a regular basis are prerequisites for a trouble-free coating process. Thus, downtimes and services by the plant contractor can be minimized. Should there be any problems which causes cannot be detected, the plant contractor's service department in charge is to be asked for information.

The requirement profile of the powder is to be coordinated with the manufacturer of the powder in the context of a quality assurance system.

Parameters that influence the separation, circulation, and film formation behavior are:

- Particle size distribution
- Density
- Melting behavior
- Resistance to caking
- Composition
- Moisture content
- Fluidization ability
- Stoving conditions

Problems which possible causes are attributed to the properties of the powder, should be reported to the manufacturer of these powders, so that appropriate remedial actions can be taken.

3. Problems during application

Problem	Identification	Possible cause	Remedial action
3.1 Fluidization	Intermittent or no delivery from the application equipment	Fluidization properties of the powder insufficient, too little fluid air; fluidized bed blocked	Contact powder manufacturer Increase pressure of fluidization air; check fluid bed tile
	Visually detectable local blistering and cratering in the fluid container	Compressed air too humid, contains oil, Powder is humid, relative humidity is too high inside the room in which the powder is processed	Check the function of the dryer for the compressed air: check oil and water separator
	Poor flowability in the powder coating circuit	Fluid bed base tile clogged or damaged Air temperature too high in the coating plant	Clean or replace fluid bed tile Comply with storage conditions and climatic processing conditions recommended by the powder manufacturer
		"Lumps" in fluidized powder	Increase vibration of powder container
		Reclaim powder too fine; Reclaim system filters blocked	Continuous automatic dosing of new powder coating, ensure a functioning cycle (recovery, filter)
	Irregular powder cloud	Powder too damp Powder Coating already highly densified in the box	Store powder dry and at room temperature Sieve powder coating, do not run cardboard vibrators in continuous operation

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action
3.2 Deposition, sinter deposits ...in hoses, in injectors	Powder cloud from spray unit looks very irregular, Powder coating spitters	Air speed too high; powder ejection too high	Reduce air speed; Distribute powder ejection to more spraying units
		Inappropriate hoses (hose material, dimension, installation, kinks, narrow radius)	Use appropriate hoses, note installation and length of hoses
... in/on spraying elements (baffles, nozzles)	Irregular spray pattern	backwashing air too low, mechanically damaged or worn parts	Increase backwashing air, clean injectors, baffles, and nozzles so that the surfaces will not be roughened or damaged
		With filter recovery: Circulation powder too fine; insufficient metered feeding of fresh powder into the circulation	With filter recovery: Continually automatically feed/add fresh powder
		Powder too humid	Check operation of refrigerant type drier regarding compressed air: check oil and water separator
		Pressure of conveying air too high	Reduce pressure of conveying air
		Pressure fluctuation inside the pressurized-air system	Check compressed-air system
		Room temperature too high, relative humidity too high	Respect climatic processing conditions
3.3 Irregular distribution of film thickness on the object	Color difference due to different substrate coating	Irregular conveying of powder, space between spray pistol and object not balanced	Optimize plant parameters,
	Surface appears irregular	Relation between line speed and conveying speed of the spray pistols not optimized (sine curves); high voltage fluctuations	Optimize "sine curves", check high voltage
		Particle size distribution not optimal	Optimize particle size distribution
		Powder column on the venturi tube fluctuates heavily	Provide for consistent feeding from the fluid bed container
		Construction of object (Faraday cage) and/or jiggging inappropriate	Change construction of object and/or jiggging
		Pressure of conveying air too high; powder coat is blown off due to air speed that is too high	Reduce conveying pressure
		Earthing insufficient	Check earthing
		Distance spray pistol – coating object too short	Increase distance

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action
Layer thickness too high	Optical or by measurement	Powder coating output too high	Reduce powder output
		Coating time too long	Reduce coating time
		Workpiece too warm/hot	Avoid workpiece temperatures > 40 °C during coating
Layer thickness too low	Optical or by measurement	Powder coating output too low	Increase powder output
		Coating time too short	Increase coating time
		Earthing not sufficient	Optimize earthing
3.4 Powder Coating adheres insufficiently ...(powder coating falls off) on flat object	Color differences due to different substrate coating	Objects insufficiently earthed; field strength too intense	Optimize plant parameters, clean suspension/jig
		Surface appears irregular	Balance set-up between forward and atomizing air
		Voltage of spraying pistols and their distance to object not optimal	Change voltage and space between spray pistols and object
		Voltage too low	Increase voltage
		Output of powder too high	Reduce powder output
		Particle size distribution not optimal	Optimize particle size distribution
		... on objects with Corners and recesses	Parts of the object remain uncoated
		Wrong spraying element attachment	Use the right spraying element attachment
		Speed of conveying air too high inside the spraying element	Reduce speed of conveying air
		Geometry of object and object suspension inappropriate for coating process	Change construction of object and/or suspension
3.5 During TRIBO applications	See above	Insufficient charging because of:	Permanently measure stray current or specific TRIBO-charge of powder respectively
		• powder throughput too high	Optimize plant set-up
		• wrong particle size distribution	Make particle size distribution consistent with plant and object
		• worn friction element inside the spraying element	Replace worn friction elements
		• powder insufficiently compatible with TRIBO	Use TRIBO powder

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action
3.6 Edge design	Noticeable pads on corners and edges of objects	Powder cloud too large, Wrap through the opposite pistols	Change powder cloud purposefully
		Distance too large between objects	Eliminate conveying of powder into suspension gaps (use gap control); minimize space between objects; shield suspension gear constructional
		Coarse particle content of powder too high	Optimize particle size distribution
Frame effect	Surface appears irregular, border area differs	Total film thickness too high	Reduce total film thickness
		Different deposition behavior on the surface of the objects	Use appropriate spray nozzles or spray nozzle attachments
		Output of powder too high, voltage too high	Reduce conveying pressure and high voltage
Sudden escape of powder from the coating booth	Powder dusts from the booth and contaminates surroundings	Inappropriate distance between spraying elements and object	Contact plant manufacturer or contractor
		Suction performance of the booth too low	Make powder ejection consistent with suction performance
		Most common cause is draught inside the plant due to open windows and doors	Close windows and doors
3.7 Electrical discharges	Sparking	Filters inside the recovery unit are clogged	Check pressure gauge differential on filters
		Insufficiently conductive hose material	Use hoses recommended by the plant contractor
		Injector insufficiently earthed	Pay attention to earthing of injectors
		Objects insufficiently earthed	Clean hangers/jigs; remove coating from jigs regularly
Discharge (electric shock) on persons		Usage of metallic powders	Use appropriate spray nozzle attachments
		Spraying enclosure insufficiently earthed	Wear conductible protective clothing Check positive earthing grips on the hand spray pistol

4. Problems on the coated object

Problem	Identification	Possible cause	Remedial action
4.1 Insufficient mechanical properties (adhesion, elongation, surface hardness); insufficient corrosion resistance and resistance to chemicals	Specification profile of the coating is not fulfilled	Film thickness beyond nominal values	Comply with nominal values of film thickness
		Insufficiently cross-linked powder	Check crosslinking/curing, comply with stoving conditions
		Heating rate too low	Increase heating rate
Insufficient intercoat adhesion in two-coat procedures (peeling)	Insufficient mechanical properties	Insufficient pre-treatment of objects (phosphating, chromating)	Optimize pre-treatment
		First coating overbaked	Set up temperature of object and holding time optimally (temperature-time-diagram)
		Inappropriate powder; film thicknesses extremely high	Coordinate assembly
		Use of a directly heated gas oven	Use different heating
4.2 Levelling (orange peel) (all areas or parts of the object)	Specification profile of the coating is not fulfilled (nominal value of levelling)	Film thickness of powder coating too high or low	Optimize powder output
		Temperature profile on the object not optimal	Optimize temperature on object
		Usage of inappropriate powder (too reactive, too high-viscous)	Use appropriate powder
		Particle size distribution of powder inappropriate	Use powder with changed particle size distribution
		Incompatibility with other powders	Clean plant thoroughly, do not mix different powders
		Back-spraying effect (voltage too high, temperature and relative humidity at the plant location changed)	Reduce film thickness, reduce voltage; check air conditioning; divert "superfluous" charge by means of special spraying elements or additional equipment such as rings for diverting ions (e.g. Super Corona, Corona Star))
		Powder stored too long/too warm	Check storage conditions
		Relative humidity too low	Increase relative humidity

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action		
4.3 Gloss deviations	Specification profile of the coating is not fulfilled (nominal value of gloss)	Stoving conditions are not being adhered to	Set up temperature of object and holding time optimally (temperature-time-diagram)		
		Special stoving technology (heating with gas direct, infrared, near-infrared, inductive heating)	Use appropriate powders		
		Bad levelling (powder stored too long/too warm)	Optimize stoving conditions, use new powder		
		Incompatibility with other powders	Clean plant thoroughly, do not mix different powders		
		Powder thermally instable	Use thermally stable powder		
		Film thickness too high, too low	Optimize film thicknesses		
		Emissions from the powder or the substrate in the course of the stoving process	Use appropriate powders, check substrate/pre-treatment		
		Deposit or condensate (from the air inside the oven)	Clean oven, increase amount of outlet air if necessary		
		4.4 Contaminated surfaces	Nominal values of surface assessment are not fulfilled	Missing sieve	Use screening machine
				Insufficient sieving	Use sieves with small mesh size
Dirt from the air inside the plant hall is deposited on the coated object due to air flow	Use screening machine with various sieves; use screening machine with automatic dirt and deposit discharge				
Dirt from the conveyor	Clean conveyor				
Dirt from the jig	Use conveyor with dirt trap				
Emissions from the powder inside the oven	Clean oven regularly; increase amount of outlet air if necessary				
Polluted air is being sucked into the booth or the oven	Provide for separation of coating plant from other factory floors; supply coating area with high-pressure filtered fresh air				
When operating two or more booths mutual suction of the powder-air mixture (especially during cleaning processes)	Provide for spatial separation of the booths				
	Check afterfilter regularly				
	Powder hose insufficiently cleaned after change of color			Clean powder hose with pressurized air and stopper	

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action
Contaminated surfaces	Nominal values of surface assessment are not fulfilled	Clothing fibers are being sucked in by the recovery unit	Use special clothing
		Fibers from the filter of the recovery unit	Use filters that will not leave fibers
		Adhering dirt particles on the object prior to the coating process	Provide for clean objects before the coating process
		Objects "cleaned" with fluffing cloth	Do not use fluffing cloths
4.5 Color deviation	Objects do not match in terms of color	Powder contains contaminations when delivered	Contact manufacturer of the powder
		Stoving conditions changed (recirculation temperature / time diagram, overstoving during breaks or downtimes, IR contribution)	Set up stoving conditions correctly
		Combustion products in directly gas-heated ovens	Use stabilized powders
		Film thickness beyond nominal values	Comply with nominal values of film thickness
		Object or operation mode changed (dimensions, mass)	Sort objects
		Insufficiently degreased or pre-treated objects	Optimize degreasing, pre-treatment
		Irregular film thickness of a priming coat	Apply primer with uniform film thickness in order to achieve even substrate in terms of colour
		Mixture of two powders	Separate powders strictly; clean plant thoroughly when changing powders
4.6 Blisters (closed or burst); „pinholes“	Specification profile of the coating is not fulfilled	Requirement profile of the powder insufficiently defined	Check or specify requirement profile together with contractor of powder
		Stoving conditions not optimal (heating rate)	Optimize stoving conditions
	Weak spots when stressed	Surface of objects not cleaned sufficiently (grease residues, rust, water, emissions from the substrate)	Clean surface of objects perfectly; contact manufacturer of pre-treatment
		High film thickness (air pockets, emissions from the powder, e.g. water)	Reduce film thickness
		Surface of the object has cavities (cracks, indentations, overlaps)	Improve surface of objects, change construction

Check list for trouble free powder coating

Problem	Identification	Possible cause	Remedial action
Blisters (closed or burst); „pinholes“	Weak spots when stressed	Blow holes on surfaces with hot-dip galvanized coat; porous surface, e.g. die casting	Temperature de-gassing of objects, use appropriate primer
		Specification profile of the powder	Use powders for outgasing substrates
		Incompatible powders mixed together (contamination)	Separate powders strictly; clean plant thoroughly when changing powders
4.7 Craters	Specification profile of the coating is not fulfilled	Objects not sufficiently de-greased, pre-treated	Optimize degreasing, pre-treatment
		Weak spots when stressed	Incompatible powders mixed together (contamination)
	Influences of products containing silicones		Avoid products containing silicones within the coating area (check air ducts of connected production units)
	Blow holes on surfaces of cast parts, hot-dip galvanized or zinc-sprayed coatings; porous substrates as e.g. die casting		Temperature de-gassing off objects, use powders suitable for outgasing substrates, use appropriate primer
	Oily dirt from the conveyor chain		Clean conveyor chain
	Oil from the pressurized air	Use and check oil separator, refrigerant type drier	
Condensates from the oven	Clean oven, increase amount of outlet air if necessary		
4.8 Drop formation	Specification profile of the coating is not fulfilled	Film thickness too high or irregular	Optimize film thickness distribution
	Fitting accuracy is not fulfilled	Stoving conditions not optimal (heating rate, object and oven temperature)	Optimize stoving conditions
		Geometry and surface profile of the objects (powder-drawing areas)	Introduce individual coating processes of objects
	Requirement profile of the powder defined insufficiently	Define requirement profile of powder	
	Wetting disturbance: "slipping" of the powder coating	Clean substrate residue-free (salts, oils, greases, residues of rust and separating agents)	

5. Specific characteristics when using metallic powders

Problem	Identification	Possible cause	Remedial action
5.1 Insufficient levelling, rough surface	from insufficient film thickness to finely textured surface	Insufficient deposition	Increase high voltage, check spray nozzles
		Output of powder too low	Increase powder ejection
		Blowing-off effect	Reduce amount of air
		Ejection of powder too high in combination with high voltage too low	Reduce powder output, increase voltage
5.2 color deviations	Objects do not match in terms of color or effect	Insufficient charging during TRIBO application	Use appropriate charging method (corona charging)
		Wrong or different charging procedure, hence a different alignment of metal effect pigments	Corona charging recommended, in any case the same procedure is to be used
		Powder being used is not correctly bonded and cannot be reclaimed; results in separation of powder base and metal effect pigments	Use powder that can be reclaimed (bonded); ensure that the ratio of virgin powder to reclaim meets the powder manufacturers recommendations; motto "Stop messing about with half measures and do the thing properly."
			Use powder "spray to waste" (costs, disposal!)
		Batch change during a job	Use same batch of powder during a job
		Powder separating in powder hopper	Use fluidized bed hopper to avoid partial separation
		Color differences between automatic and manual coating process, various system settings (kV)	If possible, do not use manual coating after automatic application but manual coating prior to automatic application
„clouding“	Appearance of irregular light-dark effects on substrate	Different substrates	Produce color standard and color tolerance standards on different substrates
		"Differences" with the customer regarding the color	Agree upon color specimen and limiting specimens
		Wrong space between spray pistols, different charging, improper sine curve, insufficient earthing	Optimize coating plant parameters, check pistols
		Obviously different film thicknesses	Minimize variations in film thickness
		Automatic coating process with subsequent manual application	Chose manual pre-coating

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