TIGER Coatings

TROUBLESHOOTING GUIDE

TIPS & TRICKS FOR TIGER DRYLAC® COATING

Dear Customer:

Powder Coating Technology, from the application of powder to the coating itself, has expanded at lightning speed in recent years. Experience and knowledge are essential for keeping pace and excelling in this arena, and will exceed the traditional factors of "work" and "capital" in value in the future.

Developing this knowledge involves learning curves and often requires years of development. Against a backdrop of intensive regional and global competition in the finishing industry, association with experts in the field of powder coating equipment and/or powder coating materials is a determining advantage.

With "Tips & Tricks for Powder Coating with Tiger Drylac®", we have attempted to categorize and comprehensively interpret several decades of knowledge for your use. Many troubleshooting solutions are provided in this handbook, as well as detailed answers to a host of questions.

We hope to provide you with assistance in your production and planning agenda with this handbook, and look forward to continued co-operation and partnering.

Your Tiger Team.

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1. PRETREATMENT AS AN ERROR SOURCE (OVERVIEW)

Tiger is not a supplier of pretreatment chemicals, therefore the following illustrations of the pretreatment of metals should only provide a short overview of sources of errors. Certainly this subject deserves more thorough exploration. The principal stands: "The best and most expensive powder coating cannot replace good pretreatment".

1.1 Chromating of aluminum, zinc, magnesium

• **Rinse beads off, insufficient wetting**

Possible causes	Corrections, testing, procedures
Degreasing power not sufficient (example: hard to remove fabricating oils, release agents which liquefy at high temperatures, pressed in extrusion greases)	Increase temperature in degreasing unit, Increase chemical concentration, Increase duration, Increase agitation

• **Conversion layer (chromating) uneven or spotty**

Possible causes	Corrections, testing, procedures
Degreasing not sufficient, unit parameters incorrectly adjusted , spray perspective not in order	Increase temperature in degreasing unit, Increase chemical concentration, Increase duration, Increase agitation
Inorganic layers (oxides) not sufficiently removed, including un-removed chromate or anodizing layers (after coating removal)	Check adjustments, check nozzles, Increase temperature or concentration of acidic solution, Increase duration
Partial drying	Increase lifting times in dipping unit. Check side nozzles in spray units

• **Conversion layer (chromating) not bonded or wipeable**

Possible causes	Corrections, testing, procedures
Bath formulation not appropriate	Correction (concentration, ph level, excellerator)
Treatment duration too long	Observe recommended duration, avoid inactive zones
Rinse tanks overburdened	Increase dripping time over active baths, Increase rinse water amounts
Rinse results not sufficient (carried into the acidic solution)	Increase mechanical action (nozzle pressure, formation, movement in dipping units), Increase rinse cycle

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- **Surface becomes black after degreasing / acidic solution, Discoloration is particulary wipeable**

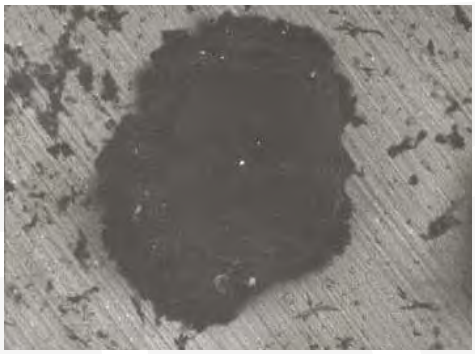
Possible causes	Corrections, testing, procedures
Insoluble egestions of alloy components caused by corroding the soluble ground metal in the degreasing and / or acidic solution	Decrease treatment time of the degreasing / acidic solution, Reduce concentration, use milder products

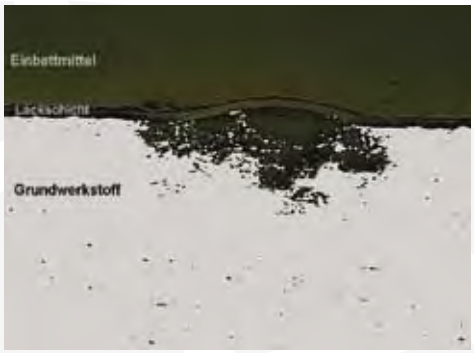

Img. 1.1.1. Spotty chromating


Img. 1.1.2. Poor (no) chromating


Img. 1.1.3. Inappropriate basket-pretreatment


Img. 1.1.4. Procrastination of the pretreatment-media


Img. 1.1.5. Residues on aluminum after pretreatment



Img. 1.1.6. Comprised pretreatment-crystals (salts, chlorides)

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1.2 Phosphating of steel and zinc plated steel

- **Rinse beads off, insufficient wetting**

Possible causes	Corrections, testing, procedures
Degreasing action not sufficient (example: hard to remove fabricating oils, pressed in extrusion greases)	Increase temperature of chemical concentration in the degreasing unit, increasing dipping duration, increase agitation, use appropriate molding additive.

- **Conversion layer (phosphating) not closed, rust**

Possible causes	Corrections, testing, procedures
Bath formulation not appropriate	Correction (concentration, ph level, excellerator)
System parameters incorrectly adjusted	Adjust, Renew chemicals
Rinse tanks overburdened (carried into the acidic solution, ph levels too low)	Increase dripping time over active baths, Increase rinse water amounts
Rinse results not sufficient (carried into the acidic solution)	Increase mechanical action (nozzle pressure, formation, movement in dipping units), Increase rinse cycle
Lapses in movement prior to layer formation	Ensure even movement

- **Conversion layer (phosphating) too thick, dusty layers**

Possible causes	Corrections, testing, procedures
Treatment duration too long	Observe recommended duration, avoid inactive zones
Excellerator levels too high	Observe recommended levels

- **Conversion layer (phosphating) too uneven of spotty**

Possible causes	Corrections, testing, procedures
Degreasing not sufficient	Increase temperature or chemicals in degreasing unit Increase dipping duration, increase agitation Use suitable molding additive.
Inorganic layers (scale, rust, oxide, hydroxide) insufficiently removed	Increase temperature and chemical concentration Increase treatment time Adjust nozzle systems
Drying	Decrease lifting time in dipping units Use side nozzles with spray units
Spray distribution insufficient	Adjust nozzles
Pre-phosphating	Test rinse water Check procedure
Activation not sufficient (with zinc phosphating)	Check correct tank adjustments Renew chemicals

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Img. 1.2.1 Fat-arrears after pretreatment

Img. 1.2.2. Primitive alternative of an oil separator

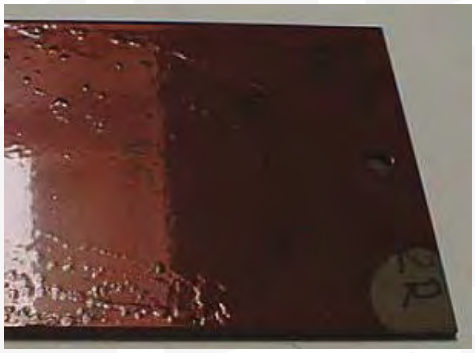
Img. 1.2.3. Corrosion caused by Fe-phosphating on radiated pieces

Img. 1.2.4. Crater in powder coating film caused by corrosion

Img. 1.2.5. Corrosion of sandblasted work pieces after pretreatment

Img. 1.2.6. Poor purging, afterwards stored wet

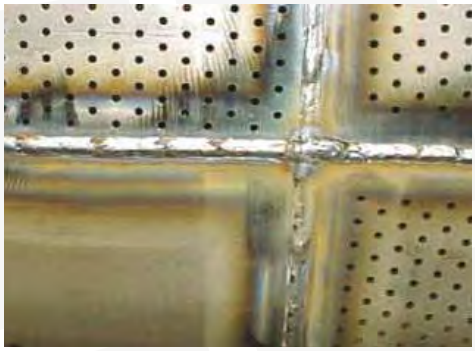
Img. 1.2.7. Poor purging, radiated, KTL-grounded



Img. 1.2.8. Poor purging, radiated, KTL-grounded and coated

Img. 1.2.9. Poor purging, radiated, KTL-grounded and powder coated - comparison

Img. 1.2.10. Pretreatment-resistant deep-drawing greases



Img. 1.2.11. Oilcoal caused by welding work

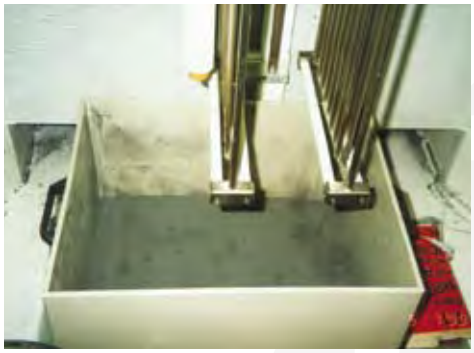
Img. 1.2.12. Procrastination of the pretreatment media

2. POWDER APPLICATION

2.1 Poor Fluidization

• **Scenario:** Powder is supposed to flow like water in the fluid container (boil). Poor fluidization is recognizable in a slow and non-continuous transportation of the powder coating from the fluid container to the guns. No homogenous powder cloud is achieved.

Possible causes	Beseitigung / Versuche / Maßnahmen
Fluidizing air too low or too high	Change pressure Use larger hose diameter
Fluidizing plate defective	Exchange plate
Fluidizing plate clogged	Clean plate
Oil remnants in compressed air	Check filter in front of coating booth
Powder too fine (reclaim), high overspray ratio	Add virgin powder, change powder
Powder moist	Dry powder and store at room temperature (max. 25 °C, 77 °F)
Powder in carton very hard or lumpy	Strain Do not set fluidizing plate to continuous operation
Excessive temperatures in the coating system	Correct condition / Provide circulation / Cool, Reconstruct


Img. 2.1.1. Fluidization - the powder has to flow like water


Img. 2.1.2. Poor fluidization


Img. 2.1.2. Poor fluidization - too much powder

2.2 Clogging of the powder feed hoses

• **Scenario:** Deposits (agglomerates) form in the powder feed hoses, which sporadically are freed by delivery air and appear as powder puffs on the work pieces. After curing these powder puffs appear as faulty surface elevations.

Possible causes	Corrections, testing, procedures
Feed air pressure too high/too low	Reduce/increase pressure
Delivery air moist or oil in pressurized air	Check in-line filters and moisture traps
Inappropriate hose mounting	Establish appropriate hose mounting, no kinks
Particle size distribution of powder coating too fine	Note appropriate particle size Optimize virgin powder plus reclaim ratio
Venturi nozzle worn	Exchange nozzle
Feed hose diameter wrong	Adjust hose diameter to appropriate powder flow
Feed hose too long	Minimize feed hose length
Inappropriate hose material	Exchange hose type, use appropriate type (silicone, polyurethane, Teflon)

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2.3 Powder does not adhere to substrate

• **Scenario:** The powder coating, which should electrostatically adhere to the substrate, falls off – no relevant coating thickness can be achieved.

Possible causes	Corrections, testing, procedures
Insufficient grounding	Test contacts and transport mechanism (especially booth) and hooks (< 1 MΩ). Insulation from lubricants and residues in transport
Voltage too low or no voltage	Gun, test high voltage, cable and cable lead
Not enough charging	Increase voltage, reduce powder flow
Wrong particle size distribution	If reclaim is involved add virgin powder, Contact powder manufacturer
Wrong grading (too coarse)	Contact poweder manufacturer
Chain does not run smooth, vibration too strong	Check conveyor system
Film build too high	Check geometry of part Reduce powder flow
Insufficient wetting	Check pretreatment
Airspeed blow of air too high	Optimize controls
Too much powder output	Reduce air flow and/or powder flow
Gun distance to part too close, blast off effect	Adjust distance
Unsuitable geometry of the part	If possible change geometry or hanging position


Img. 2.3.1. Check earthing


Img. 2.3.2. No earthing at multi coated hooks


Img. 2.3.3. Create an additional earthing

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2.4 Poor Wrapping

• **Scenario:** With one sided gun positioning only minimal film thickness can be achieved on opposite side.

Possible causes	Corrections, testing, procedures
Powder flow too low or too high	Optimize system parameters, adjust air flow
Insufficient grounding	Use clean hooks, test transfer resistance (< 1 MΩ), check diameter of hooks
Temperature of the part too high after dry-off oven or pre-heating	Allow adequate time for cooling (less than 40 °C / 104 °F]
Supplemental air flow is too high or too low	Adjust air speed and powder cloud
Unsuitable particle size distribution	Consult powder manufacturer
Gun voltage too high	Adjust voltage to suit part geometry
Insufficient charging of the powder	Adjust high voltage
Poor or wrong positioning of the parts	Adjust hanging configuration
Gun defective	Consult equipment and powder manufacturer

Img. 2.4.1. Poor wrap-around

Img. 2.5.1. Powder lumping in the box

2.5 Powder lumping in the box

• **Scenario:** Lumping in the powder coating in powder box

Possible causes	Corrections, testing, procedures
Inappropriate storage (temperature too low/too high, in excess of shelf life)	Strain before use, use fresh powder
Box feeding	Avoid continuous vibratory operation
Transport too slow or too warm	Strain powder before use, consult powder manufacturer

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2.6 Poor penetration into recesses

• **Scenario:** Despite the physical conditions (faraday cage), it is possible to achieve a minimum coating thickness in the corners. With poor penetration procedures penetration depth is very limited. Extreme film thickness variations are noticeable.

Possible causes	Corrections, testing, procedures
Feed supplemental or tribo air too high	Change of lower pressure
Air speed too high	Adjust equipment controls
Powder flow too high	Adjust equipment controls to suit part
Not enough powder flow	Adjust/optimize equipment parameters
Inappropriate application, unsuitable nozzle	Utilize flat spray nozzle or deflector; Adjust nozzle
Insufficient charging of powder, defective gun	Adjust voltage (increase, test) Contact equipment manufacturer
Voltage too high	Adjust/reduce voltage
Faraday cage effect due to electric field	Use tribo equipment and powder; Reduce voltage
Insufficient grounding	Use clean hooks, test transfer resistance
Powder spray too wide	Use different gun nozzle of deflector
Unsuitable particle size distribution	Optimize through testing; Contact powder manufacturer
Distance from gun to part is too big or too small	Increase or decrease distance

Img. 2.6.1. Additional earthing for hollows

Img. 2.6.2. Rip up caused by poor metal-production

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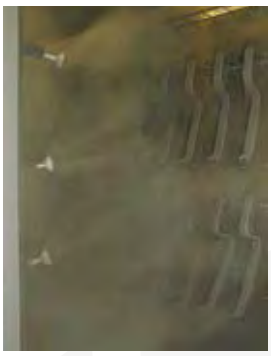
2.7 Film Thickness too high

• **Scenario:** Powder coat layer shows uneven surface prior to curing, after curing shows orange peel, wavy flow, or pinholes.

Possible causes	Corrections, testing, procedures
Parts are too hot coming from dry-off oven	Allow longer cooling time (less than 40 [°C] / 104 [°F]) for parts
Preheat temperature too high	Lower preheat temperature or allow for cooling (less than 40 [°C] / 104 [°F])
Powder flow too high	Lower powder feed
Coating time too long	Lower coating time
Unfavorable geometry of parts	Change hanging or gun configuration
Gun-to-part distance too close	Increase gun-to-part distance

Img. 2.7.1. Film thickness too high (ornateness)



Img. 2.7.2. Too thick powder cloud

2.8 Film thickness too low

• **Scenario:** Substrate shows through and powder coat has grainy flow.

Possible causes	Corrections, testing, procedures
Insufficient charging of powder	Test and adjust voltage
Inappropriate particle size distribution/percentage of over-spray too high	Continuous and even introduction of virgin powder to reclaim powder; Patio adjusted to actual consumption Optimize particle size distribution through testing
Powder flow too low	Increase powder flow
Powder delivery hose too long	Shorten hose; Change hose diameter; Change injector
Fluid characteristics of powder not optimal	Check fluidization (see 2.1 poor fluidization)
Residence time of parts in front of gun too short	Slow down line speed of conveyor; Increase number of passes of gun in front of part; Add more guns
Suction of reclaim system too high	Lower suction capacity
Booth draft too strong to allow powder cloud to deposit on its own	Change system configuration; Consult with booth supplier Slow down line speed
Changed powder supply due to powder deposits in the transport system, injectors, hose and nozzle	Cleaning of the transport system components, coordinate feed and atomized air, check fluidization
Plugged transport system due to foreign materials (e.g. fibers, cleaning residues)	Commit to cleaning cycles and regular maintenance
Inappropriate hanging of parts	Check and adjust hanging configuration
Insufficient grounding	Use clean hooks; Avoid thin hooks (note voltage loss) Check transfer resistance if system
Processing of non Tribo powders in Tribo systems	Use Tribo powder

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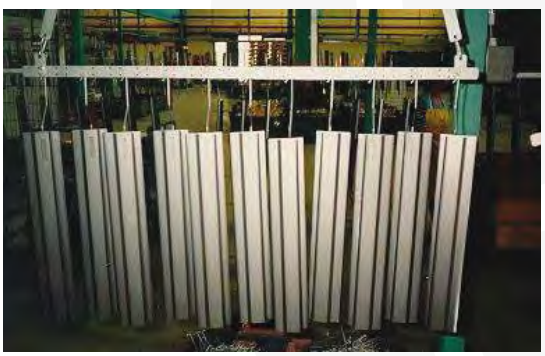
Possible causes	Corrections, testing, procedures
Low level of powder in fluid hopper	Replenish powder; Check minimum indicator
Particle size too fine due to circulation in system	Increase virgin to reclaim ratio
Too much overspray in booth due to cleaning cycles	Regular transport of overspray from booth to reclaim system
Intermittent back pulse of filter too long, sudden shift of powder particle size (too fine)	Keep back pulse of compressed air short (e.g. 20 seconds)
Insulation of base coat too strong	Reduce voltage for second coat and lower powder flow Use tribo powder coatings
Gun-to-part distance too high	Reduce distance
Powder hose causes friction charge of opposite polarity to charge generated in gun	Change hose material or ground hose

2.9 Film build varies

• **Scenario:** Substrate shows through and powder coat has grainy flow. Or powder coat shows uneven surface prior to curing – orange peel after curing, wavy flow, pinholes. These appearances vary on the surface of the work piece.

Possible causes	Corrections, testing, procedures
Wrong positioning of guns in an automated system	Empirical determination of proper gun positioning. Optimize interval curve of automatic guns. Check conveyor/ lift speed
Inappropriate insulation of base coat	Adjustment of hanging or gun configuration Additional grounding
No continuous, even introduction of virgin powder to reclaim powder based on actual consumption	Assure proper functioning of recovery system Adjust virgin to reclaim ratio
Sliding of powder film (in an improperly fused condition) due to conveyor vibration	Inspect conveyor and chain, Test grounding/charging
Flapping/swinging of the work pieces	Adjust hanging configuration, Test fastening method
Uneven powder transport	Test powder transporting devices for clogging due to foreign particles or plugs, Test for air pressure variations
Unfavorable geometry of parts (Faraday Cage)	Change hanging configuration or gun positioning Use flat spray nozzles
Geometry of parts varies greatly	Optimize device and gun adjustments to suit work piece
Excessive manual touch-up	Adjust automatic guns or possible pre-coat
Uneven manual touch-up	If possible pre-coat, Train personnel



Img. 2.9.1. Unsteady film thickness because of wrong mounting (to narrow distances)

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3 SURFACE DEFECTS

3.1 Powder puffs on the work piece

• **Scenario:** Powder puffs are powder clusters that in an improperly fused condition are visible as powder hills in the powder film. After curing these powder puffs appear as disturbing elevations on the surface.

Possible causes	Corrections, testing, procedures
Poor fluidization	See section 2.1 (poor fluidization)
Powder hose too long or diameter too large	Change hose diameter, Shorten hose, Change configuration
Powder too fine (reclaim)	Add virgin powder
Uneven transport	Test air pressure, Check for pressure variations
Clogging of the feed hoses	Note hose path, see section 2.2. (clogging of the powder feed hoses)
Powder falls off booth ceiling	Adjust/increase frequency of booth cleaning intervals
Powder falls off hanging devices	Remove/ reduce powder coat layer, check grounding
Powder build-up on deflector plate	Check atomized air
Powder falls off work piece	Test grounding, Check diameter of hoses
Catch nozzle worn	Change nozzle
Air pressure variations in powder supply system	Adjust air pressure
Level in powder supply container varies greatly	Reduce distance between minimum and minimum level
Gun nozzle defective	Check nozzle, replace
Powder moist	Use dry powder; Check for condensation (temperature difference from powder storage area to coating area), Check air filter and moisture traps in compressed air system

Img. 3.1.1. Filter residues cause powder spitters

Img. 3.2.2. Powder spitters on the cured powder surface

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3.2 Craters

• **Scenario:** defect – blank area in the powder coat, which extends all the way to the substrate (diameter up to 2 mm).

Possible causes	Corrections, testing, procedures
Insufficient pretreatment (e.g. oil and grease residues)	Test pretreatment if necessary, contact pretreatment supplier
Chemical residue, faulty pretreatment	Test pretreatment, if necessary contact pretreatment supplier
Rust, white rust on parts	Assure clean surface, apply recommended pretreatment, possibly buff or sandblast (sweep) surface
Oil in feed and/or atomizing air	Check in-line filters and moisture traps in air system
Silicones from chain lubricants or welding sprays	Use product without silicon content, educate line operators
Incompatibility with powder coatings from other manufacturers	Cleaning of coating and application equipment, contact powder coating supplier
Outgassing from substrate	Pre-heat work pieces, use OGF additive
Surrounding air contaminated	Balance air flows in plant, avoid cross drafts
Spin-off-products at the cross-linkage of the powder coating in the curing oven	Adjust the powder coating, Consult powder manufacturer, Provide enough air circulation
Work piece moist/wet	Increase drying time/temperature Note material thickness especially with anodized parts
Liquid and powder paint in same plant	Definitely avoid - reconfigure plant
Body filler or other compounds not compatible	Forced drying, test suitability
Base coat was cleaned with solvents	Preheat work piece or avoid solvents
Blasting media decontaminates surface	Do not reclaim blasting media
Back ionization effect	Adjust application, use tribo if possible
Instead of rough texture effect only penetration-to-metal and craters visible	Insufficient coating thickness

Img. 3.2.1. Crater caused by oil in the compressed air

Img. 3.2.2. Crater caused by oil residue

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3.3 Pin Holes

• **Scenario:** surface defects – development of fine pores on the surface,also leads to change in gloss level

Possible causes	Corrections, testing, procedures
Moisture content of powder too high	Testing through drying of powder/test storage conditions In cold climates, watch for condensation in powder (cold storage area to warm coating area)
Pre-reaction of powder coat	Check storage parameters, storage time exceeded Consult powder manufacturer
Trapped air	Check heat up curve Possible slow heat up curve Modify powder coating
Film build too high	Note recommendations of powder manufacturer Minimize film thickness
Incompatible with other powder coatings	Clean equipment/booth Consult powder manufacturer (if necessary change)
With rough textures, instead of effect development only pinholes develop	Film thickness too low (see 2.8 film thickness too low)
Very porous work pieces	Check for satisfactory work pieces, possible surface is too rough from sand blasting
Out-gassing from porous work pieces (cast parts, zinc galvanized material, magnesium castings, anodized materials)	Preheat parts Modify powder coating Cast anodized materials not scaled and dried

Img. 3.3.1. Pinholes caused by too coarse steel resources

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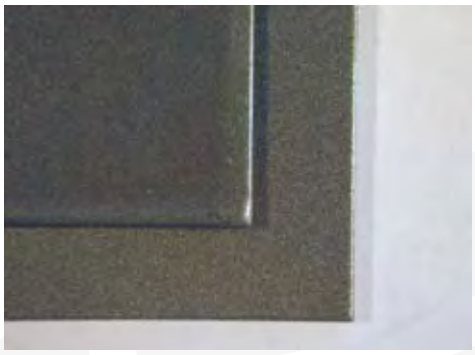
3.4 Picture framing effect

• **Scenario:** Higher film build of coating on the edges of the part due to wrap, therefore uneven flow.

Possible causes	Corrections, testing, procedures
Powder particles too rough/unsuitable for particular application	Strain powder to optimize particle distribution Consult powder coating manufacturer
Voltage too high	Adjust voltage to suit part
Distance from gun to work piece too low	Adjust/increase distance
Uneven film thickness, especially in fine textures or metallic coatings	Adjust parameters or work piece suspension
Feed air/powder flow too high	Adjust powder flow

Img. 3.4.1. Boil up of the coating caused by a too high film thickness



Img. 3.4.2. Bacon edge at the same film thickness on materials with 0,7 resp. 3 mm

3.5 Elevations, Enclosures (other colors), Contaminations

• **Erscheinungsbild:** im Pulverlackfilm eingelagerte Fremd- oder Pulverlackpartikel (andersfarbig)

Possible causes	Corrections, testing, procedures
Contamination through conveyor chain or chain lubrication etc.	Cleaning of the equipment/check sieve for contamination or tears
Contamination of powder surface due to airborne dirt from outside of booth (e.g. surrounding air, floor, polishing area, blasting area	Isolate booth area, clean surroundings with vacuum Avoid cross drafts Balance air flows in plant Avoid polishing in booth and oven area
Fibers from broom and cleaning cloths	Use suitable cleaning apparatus and materials
Insufficient polished welding areas, metal shavings, welding drops, milling flaws	Control finishing process- repeat if necessary Improve polishing stage and pretreatment
Contamination from equipment cleaning	Vacuuming is more effective than compressed air (powder is not airborne)
Deposits from dust and powder particles in the oven (too much convection inside, powder that doesn't adhere, is blown onto work pieces of different colors)	Reduce air speed Install pre-gelling curing stage Do not cure other colors at the same time in oven
Deposits of dust and powder on cured work pieces	Dust free cooling zone Avoid drafts

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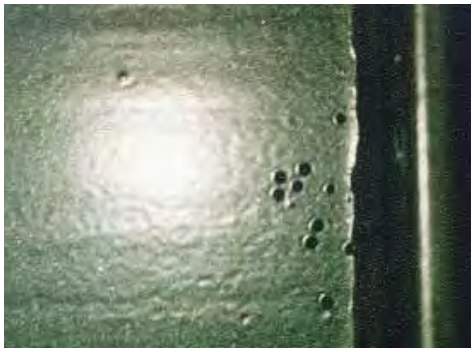
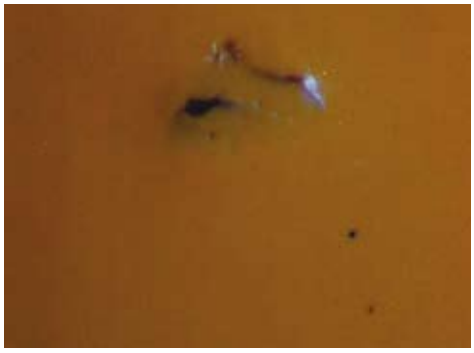
Possible causes	Corrections, testing, procedures
Dirt and color particle transfer between adjoining booths	If possible reconfigure area Enclose booths
Contamination from warehousing	Assure orderly warehousing, Close powder bags and boxes, Separate by powder type
Insufficient cleaned guns and hoses	Careful cleanining of guns and hoses



Img. 3.5.1. Bead of sweat on a work piece

Img. 3.5.2. Surface defect caused by a foreign body



Img. 3.5.3. Fibers in the powder coating surface

Img. 3.5.4. Clothing fiber in the powder coating film (cured)

Img. 3.5.5. Bitter pits caused by metal sliver in the underground

Img. 3.5.6. Uneven surface caused by poor zinc coating

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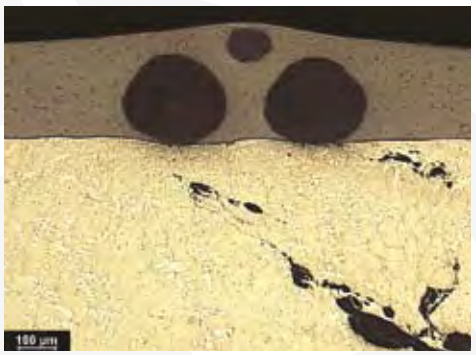
3.6 Blistering

• **Scenario:** Elevations of differing size in the powder coat, no adhesion due to enclosures at the part surface.

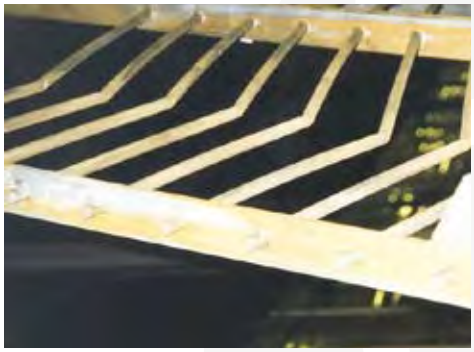
Possible causes	Corrections, testing, procedures
Water on work piece	Check dryer and hanging configuration
Water in scooping type of work pieces	Note geometry, drying time and temperature or change hanging configuration; Air blast work pieces
Corrosion, oil and grease residues	Optimize pretreatment
Over coating	Assure flawless first coat
Over coating of liquid paint	Check suitability of base coat
Over coating of filler areas	Dry or cure filler; Check suitability
Salt residues or chemical remnants on the work piece surface, insufficient wetting	Check pretreatment, final rinse stage, and drying of media/ chemicals during transport inaction
Film thickness too high, powder accumulations, powder drizzles off work piece on edges and corners	Check system parameters; Reduce film thickness
Break in zinc layer, double zinc layer, corrosion under the zinc layer	Avoid double zinc layers; Ensure flawless zinc layer

Img. 3.6.1. Corrosion as bubble causale

Img. 3.6.2. Bubbles caused by corrosion after pretreatment



Img. 3.6.3. Bubbles caused by outgassing at the die-cast aluminium



Img. 3.6.4. Bubbles caused by corrosion after pretreatment

Img. 3.6.5. Bubbles caused by tassels in the galvagnized plate

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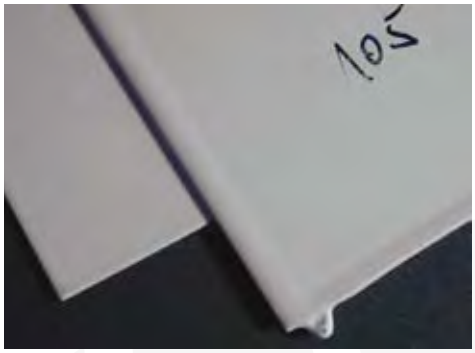
3.7 Drip Developments

• **Scenario:** Running or dripping of the gelling powder coat off the work piece

Possible causes	Corrections, testing, procedures
Film thickness too high (with wire or sheet metal parts)	Reduce film thickness
Powder slides to the edge	Increase voltage; Check grounding
Substrate temperature is too high (from preheating or dryer), therefore film build too high	Increase cooling time (max. 40 [°C] / 104 [°F]) between dry-off oven and booth; Optimize film thickness
Heat up rate too high or inappropriate	Reduce heat up speed; Control oven temperature
Powder accumulation on inside corners from drizzled off powder coating	Optimize system parameters and blast off effect

Img. 3.7.1. Drop formation caused by a too high film thickness



Img. 3.7.2. Drop formation

3.8 Orange peel

• **Scenario:** Poor flow (orange peel look), short or long waviness of powder coat layer, noticeable only after curing.

Possible causes	Corrections, testing, procedures
Heat up cycle of parts too slow	Determine heat up curve and increase (especially with parts of high wall thickness)
Substrate temperature exceeds the melt temperature of the powder, causing excessive film build	Check substrate temperature (max. 40 [°C] / 104 [°F]) Increase cool down phase
Powder coating material too reactive	Consult powder manufacturer
Shift in particle size distribution, portion of reclaimed powder too high	Optimize deposit results of powder guns Increase lift intervals
Unsuitable particle size distribution	Optimize particle size distribution; Consult powder manufacturer
Film thickness too high or too low	Check system parameters
Incompatibility with other powder coatings	Clean booth, check compatibility Consult powder manufacturer
Powder stored too long/pre-reacted	Check storage. If powder is too old, exchange
Voltage too high	Optimize voltage; Change to low ionizing application or tribo guns
Uneven wall thickness (thick to thin)	Optimize oven temperature
Back ionization effect	Reduce voltage; Increase distance from work piece to gun
Textured work piece surface	Optimize texture, check work piece surface
Air speed too high at oven entrance	Reduce air speed (max. 0.5 [m/sec] / 1 $^{1}/_{2}$ [ft./sec]), change air flow guides

Img. 3.8.1. Smashing through of the scarred surface

Img. 3.8.2. Orange peel effect

3.9 Insufficient wet out of the substrate

• **Scenario:** Poor or no adhesion of powder coat to the parts surface, large area lifting of cured powder coat

Possible causes	Corrections, testing, procedures
Gummed oils, greases or separating compounds, insoluble extrusion oils	Check pretreatment or change, use different extrusion oils or separating compounds
Pretreatment residues	Final rinse de-ionized water
Encumbrance from sweaty hands or soiled gloves	Do not handle pretreated parts with bare hands or soiled gloves
Displaced oils or greases in pretreatment	Pretreatment; Check oil separator
Conveyor halt during pretreatment, dried on chemicals	Avoid conveyor halts, possibly mist

Img. 3.9.1. Insufficient wet out caused by corrision

Img. 3.9.2. Insufficient wet out caused by oilcoal

Img. 3.9.3. Insufficient wet out of the substrate

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4. SURFACE VARIATIONS IN THE POWDER COAT

4.1 Color Deviations

• **Scenario:** Continuous or suddenly appearing changes in color or effect compared to original sample part or compared to first parts coated.

Possible causes	Corrections, testing, procedures
Film thickness varies greatly	Assure constant film thickness
Differing substrates and substrate colors (steel, aluminum, brass, glass)	Use substrates of same type for comparisons
Differing surfaces and reflections (polished, blasted, chromated)	For comparison use surfaces of same type
Film thickness too thin (not covering)	Apply higher film thickness (same as samples)
Not sufficient or wrong pigmentation in the formulation	Consult powder coating manufacturer
Color deviations due to curing technique or oven atmosphere (example: direct fired gas oven, IR oven), use of room air for burner!	Use suitable powder coatings Control oven Use outside air supply for burner
Over curing of powder coating (especially with organic pigments)	Observe curing parameters of powder manufacturer
Differing curing parameters with same parts	Observe powder manufacturers curing parameters
Differing curing parameters with greatly varying parts (different wall thickness)	Observe curing parameters of powder manufacturers and adjust to wall thickness
Several powder manufacturers/suppliers	Use powder coatings from the same manufacturer or check the compatibility
Varying film thickness with over coating	Assure even film thickness
Bleeding of first coat with over coating	Check suitability of first coat when over coating
During over coating extensive color deviations from first coat	Avoid over coating of strongly deviating colors
Uneven pretreatment of parts	Assure more even pretreatment of parts
Metamerism, color deviations with differing light sources	Judge work pieces in daylight (not direct sunlight) Use day light cabinet
Rough texture too pronounced	Use suitable powder coat
Powder transport directly from the powder box	Use fluid container

Img. 4.1.1. Color shift between RAL-cards HR and GL


Img. 4.2.2. Color shift caused by a communication mistake

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4.2 Cloud Formation

• **Scenario:** Uneven light to dark or matte to glossy effect of the coating on the work pieces

Possible causes	Corrections, testing, procedures
Gun distance from part too great or small	Test distance
Reciprocator operation parameters inappropriate for line speed and part configuration	Adjust lift speed to chain speed
Uneven powder transport	Introduce sufficient virgin powder Test for deviations in air pressure
Manual touch-up	If possible pre-coat
Uneven charging	Test application
Uneven grounding of parts	Test grounding
Strongly varying film thickness (especially with matte finishes)	Optimize film thickness
Separation of matte finish powders in reclaim system, uneven parts of virgin and reclaim powder	Assure consistent powder quality Adhere to the recommended percentage of virgin and reclaim powder

4.3 Insufficient Coverage

• **Scenario:** Smashing through of the underground through the scarred powder coating film (especially on steel)

Possible causes	Corrections, testing, procedures
Film thickness to low	Assure appropriate film thickness, especially with critical colors (example: red, orange, yellow)
Film thickness varies greatly from part to part	Optimize system parameters
Reciprocator operation parameters inappropriate for line speed and part configuration	Adjust lift speed to chain speed
Differing materials and material colors (steel, aluminum, brass, glass)	Use same materials for comparison
Differing surfaces and reflections (polished, blasted, chromated)	Use same surfaces for comparison
Mechanical treatment shows through (example: polishing)	Use finer grain materials for polishing

Img. 4.3.1. Different opacity on steel and aluminum

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4.4 Gloss Level Variations, Yellowing, Discolorations

• **Scenario:** Difference between suggested gloss level and color and the gloss level and color of the original sample or parts coated at the beginning of the job.

Possible causes	Corrections, testing, procedures
Cure parameters of manufacturer were not observed	Optimize curing parameters Adhere to powder manufacturers suggestions
Oil, soluble materials in oven	Do not use oil or soluble materials in oven area
Incompatibility with other powders, poor flow	Clean system, Distribute incompatible powders to other booths
Film thickness to high or too low	Optimize job parameters
Powder coating is not temperature stable	Use temperature stable powder coatings Consult powder manufacturer
Over curing in oven	Adjust oven temperature and speed to parts being coated Lower temperature during conveyor halts
Incompatibility of powder coating in the oven	Do not use powder coatings from different manufacturers at the same time in one oven
Direct fired ovens and IR ovens	Adjust powder coating to oven parameters Adjust oven temperature to powder coating
Powder coating pre-cured or too old	Check warehouse parameters, use fresh powder coatings
Unsuitable cleaning agents for example prior to silk screening	Check suitability of cleaning agents for powder coat, pre-testing necessary
Separation of 2 component matte powders	Check reclaim system for uneven suctioning of over spray
Uneven gloss level due to different wall thickness of work piece	Lower oven temperature, Increase duration time, Re-construct system
Components of the powder formula migrate to the surface causing haze and lower gloss	Discuss possible changes with powder supplier and consi-der trade-off between performance parameters and better stability, Optimize oven parameters
Binder in powder coating poorly dispersed	Consult powder manufacturer
Diffused liquid paints, felt pens, stamping inks, markers	Remove the residues before coating with suitable solvents

Img. 4.4.1. Stamping ink (untreated)

Img. 4.4.2. Blood supply of felt pen or stamping ink

Img. 4.4.3. Yellowing in the interior caused by UV-light

Img. 4.4.4. Color hue change caused by insufficient adhesion

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5. LACK OF TECHNICAL PROPERTIES (MECHANICAL AND CHEMICAL)

5.1 Poor mechanical properties and chemical resistance

• **Scenario:** Insufficient compliance with the necessary technical properties of the powder coating (mechanical and chemical).

Possible causes	Corrections, testing, procedures
Too high/too low heat up temperature or time	Observed curing parameters of powder coating manufacturer
Oil, grease, extrusion oils, dust on the surface	Optimize pretreatment
Insufficient pretreatment	Optimize pretreatment
Incompatible pretreatment and powder coating	Adjust pretreatment method Consult chemical and powder supplier
Inappropriate powder coating	Use appropriate powder coating Consult powder manufacturer
With transparent top coats slow deterioration of the powder coating (chalking)	Over coating of interior grade powder coatings with exterior grade transparent powder coatings does not result in a UV resistant coating system, therefore adhesion problems of the top coat


Img. 5.1.1. Chalking caused by faulty powder coating selection


Img. 5.1.2. Infiltration caused by chemical exposure


Img. 5.1.3. Metal particles oxidate at the cleaning


Img. 5.1.4. Mortar residues on the powder coat layer


Img. 5.1.5. Mortar residues on the powder coat layer (microscope view)

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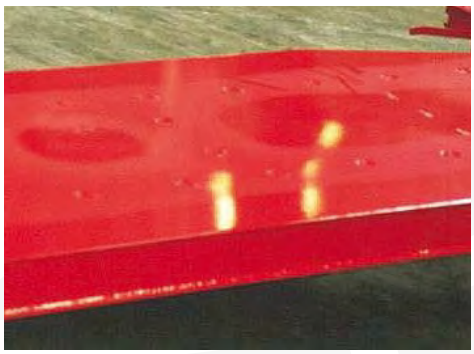
5.2 Greasy Surface

• **Scenario:** Haze like film on the surface, which can be wiped off.

Possible causes	Corrections, testing, procedures
Blooming effect (white film on the powder coating surface, which can be wiped off)	Change powder coating formula Increase curing temperature
Insufficient air circulation in the oven	Increase air circulation
Contamination on the surface because of incompatible powder coatings from different manufacturers	Use only powder coatings from one manufacturer at the same time in an oven Consult powder manufacturer
Wrong powder coating choice	Use suitable powder coatings Consult powder manufacturer
Powder coating not sufficiently cured	Observe curing parameters
Blooming-effect (accrual of a white, wipeable film on the powder coating surface)	Increase the curing temperature

Img. 5.2.1. Blooming-effect



Img. 5.2.2. Blooming-effect

5.3 Lifting of the powder coat layer

• **Scenario:** Cured powder coat backs out of the workpiece under mechanical encumbrance, no adhesion to the surface of the work piece

Possible causes	Corrections, testing, procedures
Under or over curing of the powder coating film (for example in IR oven)	Observe curing parameters
Insufficient/inappropriate pretreatment	Adjust pretreatment to job at hand
Basic material too thick or unevenly thick	Observe curing parameters, use slower or faster curing powder coatings
Scale, surface rust on the work pieces	Use “fresh” work pieces or store in dry environment; mechanical pretreatment
Oxide layer on the work pieces, white rust on zinc plating	Store work pieces in dry environment or use “fresh” work pieces; Use suitable pretreatment materials Use mechanical pretreatment (sweeping) if necessary
No adhesion on laser cut edges	Treat edges mechanically (brush, polish, sweep)
Purpose and powder coating properties are not suited for each other	Use suitable powder coatings
Film thickness too high	Reduce film thickness or use more flexible powder coatings
No adhesion to base coat	If possible lightly polish base coat or partially edge with suitable solvent

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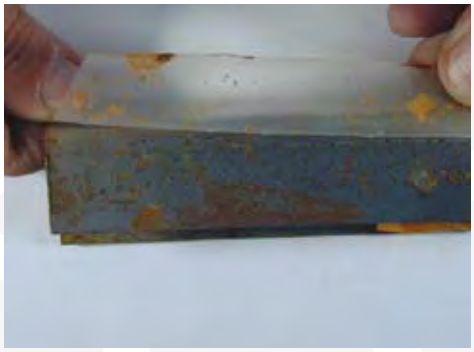
Possible causes	Corrections, testing, procedures
No adhesion to liquid base coat, electro coat or coil coating	Test suitability, lightly abrade base coat
Break in zinc, conversion or primer layer	Adjust pretreatment to work piece and powder coating
Double zinc layers, corrosion under zinc layer	Consult with H.D.G. supplier
Transport residues on work pieces (salt, dust etc), which have not been removed by pretreatment	Assure flawless surfaces and protected transportation, suitable pretreatment

Img. 5.3.1. Poor adhesion caused by direct heated gas oven

Img. 5.3.2. No adhesion of the top coat caused by directed heated gas oven

Img. 5.3.3. Blistering caused by cross-linkage

Img. 5.3.4. Blistering caused by an inappropriate pretreatment



Img. 5.3.5. Infiltration caused by an insufficient pretreatment

5.4 Abrasion resistance too low

• **Scenario:** Insufficient resistance of the powder coating against abrasive media.

Possible causes	Corrections, testing, procedures
Insufficient curing	Observe curing parameters
Packaging causes abrasion to powder coat surface	Use suitable packaging/foils to wrap work pieces (tissue paper, bubble wrap, foam, fleece)
Powder coating scratches too easily/too soft	Select suitable powder coating for purpose Consult powder manufacturer
Abrasion during further mechanical treatments (profiles)	Carefully handle work piece in further manufacturing steps
Unsuitable transport containers	Avoid sliding Transport bundled and restrained on pallets or in boxes

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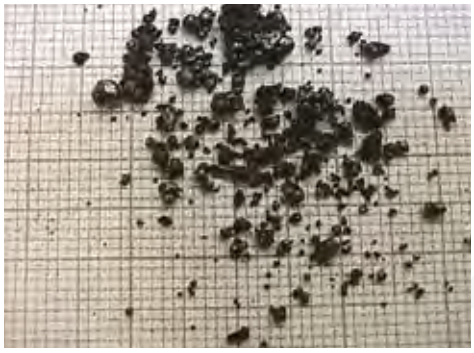
6. SPECIAL CHARACTERISTICS OF APPLICATION WITH RECLAIM

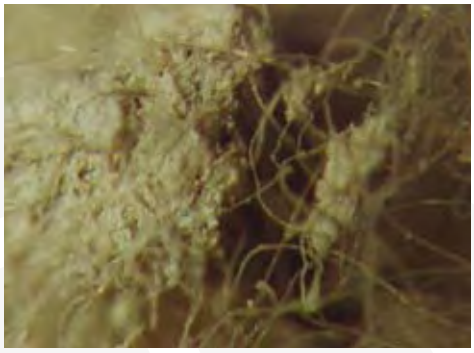
6.1 Contamination of the Powder Coating (additional to section 3.5)

• **Scenario:** Foreign or powder particles of a different color are enclosed in powder film

Possible causes	Corrections, testing, procedures
Powder remnants or dirt in coating booth, cyclone or filter	Clean system Constantly clean screen
Powder remnants in application, powder accumulation from injector, hose or gun	Clean application Check screen
Contamination of reclaim	No sieve or insufficient screen; Use proper screen size (mesh size approx. 200 [µm] / 8 [mils]); Check screen for tears or dirt
Final filter defect, powder is blown into coating area	Check and repair final filter
Chafing of carpet material in carpet systems	Use suitable carpet or replace carpet


Img. 6.1.1. CO_2 Beads of sweat in the filter residue


Img. 6.1.2. Contamination from poor equipment cleaning


Img. 6.1.3. Fibers at the reclaim


Img. 6.1.4. Dust in the filter residue


Img. 6.1.5. Dust in the reclaim powder (enlarged)

6.2 Poor Processing Characteristics (additional to section 2.1 to 2.6)

• **Scenario:** Continuously or suddenly deteriorating application while processing parameters are unchanged.

Possible causes	Corrections, testing, procedures
A change in particle size distribution due to reclaim, powder too fine	Optimize cyclone parameters; Continuously add virgin powder and ensure proper ratio of virgin to reclaim powder (max. 1:1); Reduce over spray; Change rack configuration Introduce reclaimed powder continuously

6.3 Continuous Shade Variations

• **Scenario:** Continuous or sudden changes in color/shade or effect compared to sample or originally coated parts

Possible causes	Corrections, testing, procedures
Separation or particle size distribution changes through reclaim	Add virgin powder
Powder remnants in reclaim system	Clean reclaim system
Detraction due to several booths being located next to each other	Reconstruct coating area layout; Cover booth during down-time, since powder or dirt may transfer and contaminate area
Powder transfer due to uneven air flow or performance of booths	Reconstruct/reconfigure area
With powder extraction from box feeder no even ratio of reclaim and virgin powder is achieved	Use fluid container Ensure even ratio of virgin to reclaim powder
Addition of reclaim powder is inconsistent, virgin powder ratio is too high or too low	Add sufficient virgin powder Ensure consistent ratio

Img. 6.3.1. Continuously test of the reclaim

Img. 6.3.2. Color hue change during the production

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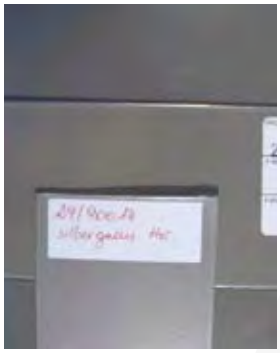
7. SPECIAL CHARACTERISTICS OF APPLICATION OF METALLIC POWDERS

7.1 Color shift from color chart or original sample

• **Scenario:** Result of the coating process not equivalent to the original color sample/tamplet

Possible causes	Corrections, testing, procedures
Inconsistent batches	Coat each job with powder from a single batch Consult powder manufacturer
Varying application (Corona, Tribo, Corona modified with ion catch)	Use only one type of application equipment Consult with powder manufacturer
Defective application, gun short circuits	Check application Use proper application
Object related coating jobs	With several applicators for one coating job, colors and systems have to be checked against each other. Use original samples, and warn customers of risks involved
Differing work pieces	For comparison always use a single work piece with its particular substrate color (aluminum, steel, zinc plated steel, glass, wood)
Poor grounding	Check ground and contacts
Wrong RAL chart used or effect difference between RAL chart and powder coating	Use proper RAL chart (GL or HR), inform customer



Img. 7.1.1 Color shift at coatings of different manufacturers

Img. 7.1.2. Effect difference at different applications

Img. 7.1.3. Color compare with the original color sample during the production

For the processing of metallic powder coatings also observe identification sheet 36 - processing guidelines for powder coatings with metallic-effect of the Austrian coating institution (see addendum).

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7.2 "Greying" of the Surface

• **Scenario:** Disappearance of the metallic or non-metallic effect components (drowning)

Possible causes	Corrections, testing, procedures
Powder coating is tribo suitable, or metallic effect appears different	Use Corona gun, always conduct pretests
Varying application methods (Corona, Corona modified with ion catcher or Tribo) and inappropriate gun settings	Adjust KV setting and gun-to-part distance: the higher the KV setting, the lesser the metallic appearance; the lower the KV setting, the more metallic effect will appear
Varying deposition of effect pigments gives rise to color/effect changes	Use one suitable application method
Different powder coating equipment	If possible fill all orders in only one coating system

Img. 7.2.1. Greying caused by cleaning compounds

7.3 Color Variations during Coating

• **Scenario:** Continuous or sudden change of color or effect from original sample or begin of coating job.

Possible causes	Corrections, testing, procedures
Powder extraction from box feeder	Use fluid container
Powder separation	Check reclaim; Spray to waste Read metallic application guidelines datasheet
Separation of powder in cyclone or in reclaim system	Check Cyclone; Check reclaim
Batch change during coating job	Use only one batch for each coating job
Color change between manual and automatic application	Touch-up difficult to spray areas before automatic application


Img. 7.3.1. False position caused by incompatibility of the flux


Img. 7.3.2. Color variations caused by reclaim

Img. 7.3.3. Color variations caused by different application manufacturers

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Img. 7.3.4. Effect-deviations caused by reclaim

Img. 7.3.5. Color-deviation at dormant caused by two different shades in the oven

7.4 Cloud Formation

• **Scenario:** Uneven light to dark effect of the coating on the work piece

Possible causes	Corrections, testing, procedures
Gun distance to work piece to big or too small	Check distance
Reciprocator operation parameters inappropriate	Check lift and chain speed
Uneven powder transport	Add sufficient virgin powder Check compressed air for variation
Manual touch-up	Position manual touch-up before automatic booth
Uneven charging (defective gun)	Check application
Uneven grounding of work pieces	Check grounding
Extremely varying film thickness (especially with matte coatings)	Optimize film thickness
Powder extraction from box feeder	Use fluidizing hopper

Img. 7.4.1. Cloud formation at metallic

Img. 7.4.2. Cloud formation caused by different film thickness

Img. 7.4.3. Sweat-cinder not removed

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8. TERMINOLOGY

The following is a brief overview of the most commonly used terminology in the powder coating industry. It should be noted that the explanations were not intended to be scientifically and linguistically correct terminology, but rather a collection of commonly used terms for the purpose of creating a general understanding.

A

Additive
Materials added in powder production to optimize powder film for certain applications

Adhesion
Sticking of the powder coating to the work piece; Mechanical anchoring and/or chemical connection between powder coating and substrate surface. Prerequisite is proper pretreatment

Adhesive Remnants
Remnants that are not removable by pretreatment cause these surface defects and adhesion problems

Agglomeration
Powder which does not adhere to the work piece or does not get recycled, but rather piles in the booth

Anodizing
Surface treatment for aluminum, establishment of a (colored) aluminum oxide layer and its subsequent solidification

Application Equipment
Equipment necessary for powder application, I.e. guns, charging equipment, nozzles, hoses etc.

Additive
Equipment necessary for powder application, I.e. guns, charging equipment, nozzles, hoses etc.

Atomized Air
To support spray cloud, also to help avoid sintering at the corona needle and deflector

Atomizing Air
Supplemental air to regulate amount of powder in the gun, higher supplemental air – less powder coating, smaller powder cloud

Automation
Powder application in connection with automatic guns (permanently mounted on reciprocator or robotics)

B

Base Material
Substrate

Bonding Agents
Main components of powder coatings, resins like epoxy, polyester, polyurethane or acrylic

Booths
Cabinet for coating (steel, stainless, glass, plastics)

Bubbles
Elevations in the powder film caused by water, salt and oil remnants etc

Bubbling
Gassing of the powder itself at high mil thickness (starting at 150 [µm] / 6 [mils]), especially with TIC-free powders and IR ovens)

Buchholz Hardness
Test procedure to measure the resistance of powder coating surfaces against pointed pressure demands; DIN 53 153/ISO 2815

C

Carbon
Burnt oil or grease on the work piece, burnt in through welding

Chalking
Decomposition of the resin and bleaching of the pigments through UV light or chemical influence

Charging
Electrostatic charging of the powder through corona or tribo method

Chemical Resistance
Resistance of the powder coat surface against various chemicals

Cleaning
Cleaning of powder application unit during color change. A necessary evil of powder coating

Coating System Maintenance
Necessary regular servicing of the coating system by the system manufacturer

Color
Perception transmitted by the eye, caused by light sources and light reflexes

Color Deviation
Difference in color from original sample to test part (color chart to work piece or work piece I to work piece II)

Color Standard
Official color charts, which represent industry standards (RAL, Pantone)

Contamination
Dirt

Conveyor Halt
Materials added in powder production to optimize powder film for certain applications

Corona Charging
See e-static

Corrosion
The reaction of a metallic work piece with its surrounding environment, which causes measurable changes affecting the function

Crater
Surface defects, which reach through the powder film to the surface

Cratering of Hammertone Effects
Through insufficient grounding, development of star shaped voltage craters that expose the underlying surface

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Crosslinking
The setting up of chemical links between the molecular chains of a resin to form a three-dimensional network polymer system

Curing
Complete fusing of the powder coat. Minimum time and temperature are required

Cyclone
Device to return and circulate oversprayed powder. Always requires a final filter

D

De-ionized Water Rinse
Final stage of pretreatment with salt free water (0 – 15 tds)

Development of Stripes
Uneven film thickness caused by uneven sinus curve

Dip Pretreatment
Pretreatment for parts, not suitable for scoop shaped parts

Dirt
Mainly contributes to reduce quality of coating (dust, fibers, shavings etc)

Distance I
Distance from gun to work piece

Distance II
Distance between work pieces

Dry-off oven
Oven (chamber) for drying parts after liquid chemical pretreatment

Duration Time
Time a coated part remains in the curing oven

E

Edge Deposits
Powder accumulation at the work piece edge

Environmental Conditions
Existing climate and environmental conditions in the coating area

E-Static
Electrostatic charging of the powder particles in the area of corona discharge, whose voltage is produced by the electrode inside the gun or co conveyed by cable

F

Faraday Cage
A physical phenomenon – the area of a part where the electric field does not penetrate

Filiform corrosion
Thread like development of metal hydroxides (not Al2O3)on aluminum surface, shows as thin threads with sharp edges under the powder coating

Film (Float)
Surfacing of additives in the powder coating, example OGF additive

Film (Haze)
Undesirable haze on powder coat surface

Film Thickness
Thickness of the powder coat

Filter
Used to separate the powder-air-mixture (overspray) in reclaim system (plate, pocket or cartridge filters)

Final Filter (Purification Filter)
Final filter in the coating system for micro particles, which are not eliminated by the reclaim system

Fish eyes
Same as craters

Flow
Smoothness of the powder coat film

Fluidizing
Stirring of powder coating in the fluid container or powder storage box via pressurized air

Fluidizing base
Air permeable sinter material in the powder storage container. Powder is fluidized through incoming air (0.3 – 0.5 bar).

Fresh Water Rinse
Rinse stage in the pretreatment system to rinse cleaning chemicals with fresh water

Friction Charging
See Tribo Charging

G

Galvanized Zinc Plating
Application of an approximately 5 – 15 [µm] / 0.2 – 0.6 [mils] layer of corrosion protection (zinc) via electrolytical separation of watery, acidy or alkaline zinc electrodes

Gas Quality
Gas used to heat the dry-off oven and powder curing (natural gas, city gas, butane, propane). Heating value and blend are of essence

Gassing
Ingredients in the substrate, which through melting of the powder on the surface escape (evaporation, air, gases etc.) can cause irregularities in the powder film

Gel Particles
Unopened resin particles in the powder coating

Glass Point
Transition phase of the powder – gelling

Gloss
Reflection capacity of a surface, with powder coatings ranging from glossy to flat mat.

Graininess
Ingredients in the substrate, which Surface defects, elevations in powder film

Grounding
Contact by work piece and coating system component with earth/ground

Gun
Necessary for charging and application of powder coat (Corona charging and Tribo)

H

Hanging Devices
For suspension of work pieces during the coating process

Heat Up Speed
Time required to heat an object to required temperature

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Heater
For pretreatment and powder drying; gas and oil, direct/indirect, electric, IR

Hiding Power
Ability of the powder, given appropriate film thickness, to sufficiently hide the color of the substrate

Hose
Comp. Transport hose

Hot Dip Galvanizing (H.D.G.)
Corrosion protection- application of an approx. 30 – 80 [µm] / 1 – 3.2 [mils] thick zinc layer by dipping at high temperatures (approx. 400 [°C] / 752 [°F])

I

Incompatibility
Condition of the surface through uncontrollable chemical reactions

Infiltration
Development of corrosion through moisture and salts (osmosis) between powder coating and part

Injector
Venturi pump for powder transportation

Insulation of work pieces
Insufficient grounding, caused by excessive film thickness on parts and hanging devices

Intercoat Adhesion
Adhesion between first and second powder coat layer

Ionization
Comp. e-static

L

Lifting
Cured powder coating lifts from substrate under various types of mechanical stain (i.e. during deburring, cutting, milling)

Lubricants
Oils and greases used to help in gliding during forming of profiles in the manufacturing process

Lumps
Clustering of powder coating in the box due to transportation, moisture influence, Corona charging or heat

M

Material Selection (Powder Coating)
Suitable powder coating (exterior vs. interior coating, special effects etc) for an application

Material Selection (Substrate)
Suitable, coatable materials (steel, aluminum, glass) for the application

Matting
Reduction of the gloss level, powder coating surface appears lower in gloss level

Mechanical Properties
Necessary properties of the powder coating (test according to ASTM, example: Conical bending or impact test, Erichsen cupping etc)

Metal Shavings
Machining residues on parts (cutting, polishing, drilling etc)

Metallic Pigments
Conductive or non-conductive effect producers in powder coatings

Metallic Powder Coatings
Effect powder coatings with metallic appearing surface (pearl, glitter, Glimmer etc)

Metamerism
Color difference at varying light conditions

Moisture
Absolute moisture content in a powder coating

Movement of Reciprocator
Spray pattern with reciprocating guns, influenced by conveyor speed and lift

N

Nozzles
Various end pieces on the gun (powder bells, finger nozzles, round and flat type nozzles)

O

OGF-Additive
(OGF = Out-gassing Forgiving) Additive to help reduce out-gassing of the substrate in the powder film

Oil Remnants
Remnants of oil on parts, which were not removed by pretreatment (Lanolin, extrusion oil etc.)

Oil Residues
Residues not removed by pretreatment

Orange Peel
Short or long ripple effect on the powder surface

Oven Types
Oven differences through construction and heating unit, i.e. chamber oven, conveyor oven, radiation oven, IR oven (comparable to heating, gas quality)

Over Coating
A second layer of powder is applied

Over Curing
Temperature in the curing unit is too high, or time in the oven is too long.

Oversize Particles
Powder particles that are larger than the screen size and are separated during straining

Overspray
Powder coat that does not adhere to the surface during application

Oxide Layer
Corrosion residues on the work piece surface

P

Particle Distribution
Distribution of powder coat particles according to size and percentage

Penetration
Ability to coat in to the corners, recesses and hollow areas

Pickling
Caustic, watery cleaning procedure, which removes oxide layers, rust, ground in dirt and foreign materials

Picture Framing Effect
Higher film thickness of the powder coating on the edges of the work piece, caused when current is too high at the edges, e.g. noticeable with fine textures and metallics

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Pigments
Coloring agents in the powder coating

Pimple
Elevation in the powder surface

Pin Holes
Surface defect. Development of small pores in powder coating

Polishing Marks
Mechanical surface treatment. Can be visible through powder coats

Powder
Dry, dust like thermosetting coatings

Powder Adhesion
See adhesion

Powder Center
Compact device for powder transportation, made of thread with integrated cleaning unit

Powder Circulation
Transport of unapplied powder through reclaim for re-use (comp. to over spray)

Powder Clusters
I.e. powder puffs

Powder Dryer
Necessary device for gelling and drying of the powder coating film(see oven types)

Powder Film
Desired surface development of the gelled powder coating

Powder Hose
Comp. To transport hose

Powder Puffs
Agglomeration of powder coat on the coated surface

Powder Transport Device
For transport of powder coating from storage container to gun

Pressure Points
Visible notches in the powder coat surface, caused by too much pressure strain, especially at high film build

Pretreatment
Cleaning and conversion layer development with liquid chemicals (dipping, spraying)

R

Reclaim
Device to reclaim over spray

Release Agent 1
Sprays used in the metal fabrication industry, to reduce the adhesion of welding residues

Release Agent II
Liquid used for castings, to reduce the adhesion between cast part and casting mold

Remnant Powder 1
Contaminated powder from reclaim

Remnant Powder II
Economically not usable powder coating in carton or warehouse

Retracted Areas
Areas unreachable with powder (i.e. faraday cage), example: form tubing, welded parts

Return Point
Up and down end points in automatic reciprocating powder coating equipment

Rinse
Removal of pretreatment residues via fresh or de-ionized water

Run
Running of the powder coating film from the work piece (synonymous with liquid paint)

Rust
During corrosion of iron or steel

S

Salt Residues
Unremoved residues after pretreatment

Scratch Resistance
Durability of the powder coating surface (i.e. abrasion resistance)

Screen Tear
Defective screen used to qualify powder, oversize particles may cause flow problems

Screening Analysis
Determination of particle size

Screening Equipment
Integrated in reclaim system to strain powder. External straining possible (min. mesh size approx. 200 [µm] / 8 [mils])

Scuff Resistance
Powder film resistance against abrasive media, i.e. sand, scouring liquid, cardboard, wood, paper

Security Standards
Security standards published by equipment manufacturers and OSHA must be observed

Shavings
Fine manufacturing contaminations (metal, wood or plastic)

Short Circuit
Uncontrolled (electric) contact between high voltage and ground

Sintering
Depositing of powder in the powder feed system, application equipment or reclaim system

Snowboard Effect
Powder does not adhere to work piece, slides off in sheets, drizzles off

Softener
Additive used in plastics production

Softening
Softening of the powder coat film through use of solvents

Spikes
Elevations

Spray Wash System
Pretreatment of work piece via spray washer(approx. 1,5 bar) mechanical cleaning power

Spraying
Application of powder coat to part with spray equipment

Stability
Continuous resistance depending on requirement, for example against chemicals, weather or UV influence

Substrate
Work piece, to be coated material (steel, aluminum, stainless steel, glass, plastics, MDF)

Super Fines
Spectrum of particle size distribution of the powder coating (< 10 [µm])

Surface Defects
Damages to the surface properties of the powder coating

Sweeping
Light blasting of parts. Mechanical removal of corrosion layer, especially for hot dipped galvanized parts

T

Tears
Surface defects, tearing/breaking during insufficient gelling, after mechanical strain

Temperature Curve
Elevating and dropping of substrate temperature during the curing process

Textures
Surface developments

TGIC
Triglycidylisocyanurate - Popular hardening system for polyester

TGIC-Free
Alternative hardener

Thermoplastics
Re-formable plastics that can be re-shaped with re-heating

Thermosetting Coatings
Irreversibly fused film, not changeable by re-heating

Transport Hose
Hose used to transport powder and air mixture from powder container to gun

Transportation Air
Necessary air to transport air to the powder gun. Increasing of air = increased powder consumption

Tribo Charging
Through charging separation (PTFE–rod) powder particles are positively charged and transported to the part

U

Use of Adhesives
Large selection, check suitability before use

V

Voltage
Necessary electrical voltage for charging

W

Wall Thickness
Material thickness of the work piece

Welding Points
Surface treatment. May be visible through powder coat. Problems with carbon

Work Piece
See substrate

Wrapping
Accumulation of powder on the backside and/or edge of a work piece

Y

Yellowing
Color change caused by excessive temperatures or time in direct fired gas ovens

Z

Zinc Coating
Application of a corrosion protection layer (Zn) on steel (galvanizing)

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Metallic Powder Coatings

Application Guidelines for Powder Coatings with Metallic Effects

Data sheet 36

This data sheet is intended as a guide for the applicator, informing the user on parameters that have considerable influence on the quality of the finish. Caution must be exercised when working with metallic effect powder coatings. Prior to application, the suitability of the entire coating system must be established by comparison with the powder manufacturer's reference samples. Otherwise no assurances can be given with regard to the color or metallic effect. The following recommendations are necessary for satisfactory results:

COLOR DEVIATIONS

Powder coatings are formulated and manufactured to meet color standards: i.e. the RAL standard. Despite the stringent quality control measures exercised during production, a complete **batch-to-batch consistency** cannot be guaranteed. For exact evaluation of color/effect, upon request, the manufacturer therefore supplies production panels of individual batches. **Batch-to-batch consistency** of products supplied is comparable to that of non-metallic powder coatings. Color deviations between two batches – depending on color – may with lighter shades be at approximately 1–2 Delta E, with darker shades possibly significantly more. However, application process and equipment are also factors in the final color/effect of the coating and have not yet been included in the above values. Evaluations according to car industry standards are not admissible. An acceptance test must be performed on the actual application equipment before processing. Those color/effect variables, particularly with regard to share of **recycled powder**, must first be established via an upper and lower tolerance sample. To largely eliminate color/effect differences caused by the coating system, an entire coating job must be processed on the same coating line, without parameter fluctuations, preferably without interruptions and with consistent recycling percentages (guideline: 30%). **Manual coating** is likely to produce variations of color and/or effect due to inconsistent film thickness. Manual coating must therefore be adjusted to automatic processing with respect to color and effect. **Coating thickness** is of importance as variations will cause color/effect and gloss differences.

Color/effect variations inherent to metallic coatings are primarily linked to content of metallic pigments. Generally fine flakes of metallic pigment are used. Positioning of those flakes within the applied coat determines the metallic effect and color. Experience has shown that any **parameter of application** may influence the position of the flakes and thus also color/effect. It is therefore important that throughout an entire coating job all equipment is left at precisely the same settings. Coating one entire job with a variety of equipment should be avoided, or else considered only after exact adjustments and comparisons produce identical test results with different equipment. Separate tests shall be carried out in order to determine to which extent color changes are to be expected as a result of specific component geometries.

RECLAIM

To achieve a consistent color/effect it is important for the coater to establish **a ratio of virgin and reclaim powder** and adhere to this ratio during the entire coating process. The ratio of virgin powder should not fall short of 70%. Repeated or exclusive use of reclaimed powder is not advisable. Since not all metallic effect powders are reclaim-consistent, the virgin powder percentage must be established via **upper and lower tolerance samples**. A final quality inspection for color is still highly advisable.

APPLICATION EQUIPMENT

Different **powder coating guns, systems and spray parameters** are often the cause for varying results. It is very important to only work with nozzles suitable for metallic powder application. Depending on the type of object to be coated, powder should be applied with a flat-spray type nozzle or with an aerated impact disk, in an even cloud pattern. **Grounding** and **charging** of the powder cloud must be constantly monitored. **Interim cleaning** of the powder hoses and removal of deposits from powder guns and

booths is also part of a regular process control. Metallic powder coating should exclusively be done from **fluidized powder containers**. Since metallic powder coatings react more sensitively to differing reclaim ratios, the coating should from the very beginning be at approximately 30% reclaim (initial coating without parts).

CHARGING

Generally very few metallic powder coatings are suitable for tribo application. Suitability must be established prior to a coating job. Due to the differing changing characteristics of powder coating and metallic particles not all metallic particles are transported to the part to be coated. This too can cause a variation in color/effect. Changing from electrostatic to tribostatic charging is not permissible. With metallic powder coatings a particularly clean coating system is very important in order to avoid short-circuiting in the gun area from powder deposits. Once again the importance of constant control over the charging of the powder cloud is stressed.

GROUNDING

When working with metallic powder coatings proper grounding of equipment as well as work piece is very important. This contributes to a high degree of **color/effect consistency**.

COATING DURABILITY

Generally the durability is determined by the processing system – one or two coat. The durability of a metallic powder coating is **product-specific** and therefore we recommend consulting the powder manufacturer prior to application, with particular reference to special requirements, such as wear and scratch resistance, cleaning recommendations, colorfastness and chemical resistance.
The manufacturer needs complete **information about all of the requirements** that the powder coating is subjected to in a project / application in order to give appropriate advice. This includes all materials that the coated part may come in contact with during final installation, i.e. glazing aids. In the case of materials of unknown chemical influence, tests must be performed after consultation with the coating manufacturer. This might necessitate a clear top coating to establish a barrier that prevents color/effect changes caused by those materials, to the metallic coating. Please note established 2-coat curing parameters.

CLEANING

Cleaning of metallic powder coated materials must be performed at regular intervals and as quickly as possible after they get soiled. Dried and old dirt can only be removed by scouring, which means scratching of the powder-coated surface. It is highly advisable to follow the cleaning recommendations of the manufacturer.

GENERAL RECOMMENDATIONS

A primer should be applied on parts that are difficult to coat, since a subsequent touch-up job may produce clouding. When both sides of a finished part must be coated, the side most visual in its final use should be coated last. The **final orientation** of curtain wall panels on a building must be established prior to coating and all panels must either be coated horizontally or vertically to achieve the same color/effect throughout a coating project. Variations in the heat-up period are to be avoided: parts of **varying wall thicknesses** cannot be coated at the same time. Please observe and consult the powder coating-instruction sheet.

Working with metallic powder coatings requires precision. All stipulations of these guidelines shall be observed. What is most important is proper communication between coater and the customer, but also between coater and coating manufacturer, to assure that all provisions are given for a quality finish.

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Proper use

This manual is intended to provide the relevant reader and user with a tool to clarify the major sources of errors in the individual application stages and to allow these error sources to be rectified as comprehensively as possible. Under these circumstances it is acceptable to quote from the relevant documents for your own requirements.

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