




POWDER
COATINGS

Service Guide Metallic Substrates

The IGP Service Team provides professional support for the processing of IGP powder coatings.



There is an
answer to
every surface.



Dear customer,

You are fully aware of the challenge – your customers demand flawless surfaces in consistent quality. Meeting this requirement pushes you, as a powder coater and plant operator, to your limits every day.

To successfully accomplish this task you need the support of capable partners in the areas of pretreatment, powder coating, and plant-specific know-how. This enables you to satisfy your customers' demands for high quality – by drawing on the deep pool of experience and coating expertise within your company. You accept support from your partners, train your employees regularly, and thus know precisely what needs to be done to avoid flaws in the coating process.

In this IGP Service Guide you will find an additional repository of answers and expert knowledge – as well as tips and tricks on pretreatment, the coating process, and other topics. The IGP Service Team offers professional support for the processing of IGP powder coatings.



Your IGP Service Team



IGP training & education program
Boost your skills. Advanced training
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IGP Service Center
The right powder coatings
and settings.
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1. Pretreatment

IGP works with various pretreatment manufacturers to ensure the optimum combination of new pretreatment technologies and our powder coatings. Nevertheless, the information we provide with regard to pretreatment is only a general overview based on our experience. Appropriate pretreatment is essential for a high-quality surface and durable corrosion protection.

1.1. Pretreatment of aluminum

1.1.1. Rinsing water forms beads, insufficient wetting

Likely cause	Recommended solutions
<ul style="list-style-type: none">Insufficient degreasing effect due to poorly soluble oils/greases, high-temperature release agents, cured release agents	<ul style="list-style-type: none">Increase degreasing temperature, increase chemical concentration, extend treatment time, increase spray pressure
<ul style="list-style-type: none">Impaired effectiveness of the chemical due to new release agents	<ul style="list-style-type: none">Discuss with material and chemical supplier

1.1.2. After etching: surface becomes discolored, stained or milky/cloudy

Likely cause	Recommended solutions
<ul style="list-style-type: none">Milky oxidation products on the surface due to poor etching attack	<ul style="list-style-type: none">Increase etching temperature, increase chemical concentration, increase injection pressure
<ul style="list-style-type: none">Insoluble, dark etching slurries on the workpiece	<ul style="list-style-type: none">Increase rinsing times, check conductivity of the rinsing water, extend pickling time
<ul style="list-style-type: none">Insoluble alloy components from the metal in the etching bath	<ul style="list-style-type: none">Milder etching (reduce concentration, time, and temperature)

Notes

1. Pretreatment

1.1.3. The conversion layer forms stains, dry edges

Likely cause	Recommended solutions
<ul style="list-style-type: none">Dried residues from the pretreatment on the workpiece	<ul style="list-style-type: none">Extend rinsing time, check conductance of the rinsing fluid

1.2. Phosphating of steel and galvanized steel

1.2.1. Rinsing water forms beads, insufficient wetting

Likely cause	Recommended solutions
<ul style="list-style-type: none">Insufficient degreasing effect due to poorly soluble oils/greases, high-temperature release agents, cured release agents	<ul style="list-style-type: none">Increase degreasing temperature, increase chemical concentration, extend treatment time, increase spray pressure
<ul style="list-style-type: none">Impaired effectiveness of the chemical due to new release agents	<ul style="list-style-type: none">Discuss with material and chemical supplier

Perfect pretreatment
for perfect surfaces.



Stains on coated workpiece

Notes

1. Pretreatment

1.2.2. Phosphate layer not sealed, corrosion

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Composition of the bath NOK	<ul style="list-style-type: none">• Check bath values, if necessary prepare new bath
<ul style="list-style-type: none">• Incorrect system parameters	<ul style="list-style-type: none">• Check parameters, observe manufacturer specifications
<ul style="list-style-type: none">• Heavily contaminated rinsing baths (carryover)	<ul style="list-style-type: none">• Check conductance and dripping water, replace rinsing baths if necessary
<ul style="list-style-type: none">• Insufficient rinsing effect	<ul style="list-style-type: none">• Increase rinsing times, check/clean spray nozzles

1.2.3. Phosphate layer too thick, dusty

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Excessively long treatment times	<ul style="list-style-type: none">• Adhere to manufacturer specifications, avoid interruptions

1.2.4. Uneven, spotty phosphate layer

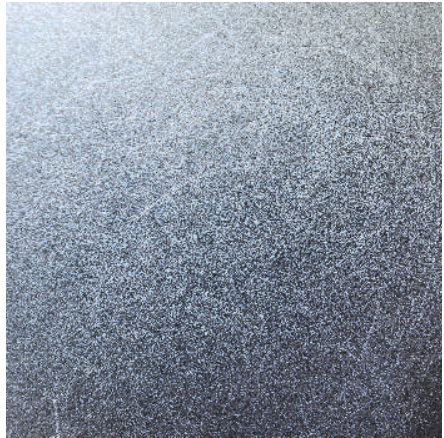
Likely cause	Recommended solutions
<ul style="list-style-type: none">• Not sufficiently degreased	<ul style="list-style-type: none">• Increase degreasing time and degreasing temperature, increase concentration; check whether new release agent was used on the workpieces
<ul style="list-style-type: none">• Insufficient etching	<ul style="list-style-type: none">• Increase etching time and temperature, increase concentration, blast beforehand
<ul style="list-style-type: none">• Dried-on chemicals	<ul style="list-style-type: none">• Prevent the chemicals from drying out between treatment zones
<ul style="list-style-type: none">• Uneven spraying (spraying systems)	<ul style="list-style-type: none">• Check nozzles for clogging, check for defects

Notes

1. Pretreatment



Bimetallic corrosion/galvanic corrosion



Grinding traces

1.3. Mechanical pretreatment

1.3.1. Bimetallic corrosion/galvanic corrosion

Likely cause	Recommended solutions
<ul style="list-style-type: none">Corrosion due to contact with various metals	<ul style="list-style-type: none">Never use blasting agents containing iron/steel on chrome steel or aluminum; do not use the same abrasive paper first on steel and then on aluminum; do not use steel rivets for aluminum, do not use aluminum rivets for steel

1.3.2. Grinding traces/sanding marks

Likely cause	Recommended solutions
<ul style="list-style-type: none">Preliminary work carried out with abrasives that are too coarse	<ul style="list-style-type: none">Use suitable sandpaper or particle size; do not skip more than one particle size
<ul style="list-style-type: none">Blasting pressure too high / abrasives too sharp	<ul style="list-style-type: none">Select suitable pressure, change abrasive

Notes

2. Coating

2.1. Fluidization

Fluidizing the powder enables the injector or pump to feed the powder through the powder hose to the guns as gently and evenly as possible. For this purpose, the powder is put into a state of suspension. The surface of the fluidized powder should move slightly, but should not exhibit air bubbles, holes or powder fountains. Furthermore, no powder should be blown out of the container.

2.1.1. Poor fluidization (holes/air channels in the fluidized surface)

Likely cause	Recommended solutions
• Insufficient fluidizing air volume	• Increase the fluidizing air volume
• Fluidizing bed defective or clogged	• Clean or replace fluidizing bed
• Water or oil in the compressed air (powder sticks to the container)	• Check compressed air, use oil separator
• Temperature too high	• Cool the room and compressed air
• Excessive fine fraction from reclaiming	• Increase fresh-powder content

2.1.2. Poor fluidization (blistering/powder leaks from the container)

Likely cause	Recommended solutions
• Excessive fluidizing air volume	• Decrease the fluidizing air volume



Holes/air channels in fluidized surface



Blistering in fluid container

2. Coating

2.2. Powder deposits in the powder hose

The powder is not conveyed evenly through the powder hose and is deposited inside it. This leads to a build-up that is then ejected suddenly from the powder hose. This results in irregularities in the coating thickness and visible spitting on the surface.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Worn collector nozzle	<ul style="list-style-type: none">Check or replace collector nozzle
<ul style="list-style-type: none">Insufficient proportion of dosing air	<ul style="list-style-type: none">Reduce powder quantity, increase total air quantity
<ul style="list-style-type: none">Unsuitable hose routing	<ul style="list-style-type: none">Avoid kinks and tight curve radii
<ul style="list-style-type: none">Hose constriction	<ul style="list-style-type: none">Check hose for constrictions due to cable ties or similar
<ul style="list-style-type: none">Powder hose too long	<ul style="list-style-type: none">Shorten hose or increase total air volume



Grounded powder hose



Example of an injector

Notes

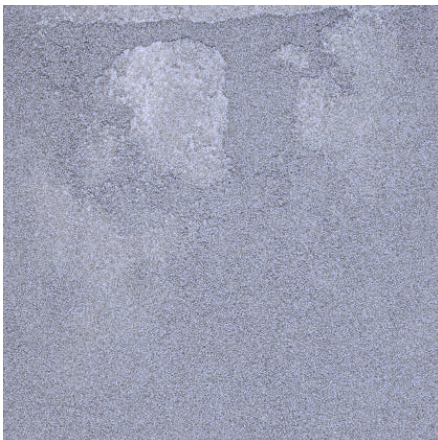
2. Coating

2.3. Shedding/detachment before curing

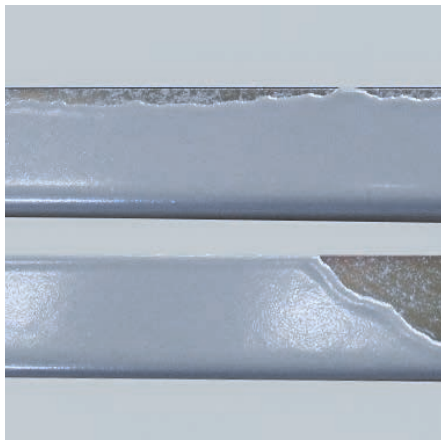
2.3.1. Powder falls off before curing (poor transport adhesion)

The powder does not adhere to the surface after spraying or falls off when slightly shaken.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Inadequate grounding	<ul style="list-style-type: none">• Clean hooks (bare metal) and measure the resistance to ground ($< 1 \text{ MOhm}$)
<ul style="list-style-type: none">• Insufficient charge	<ul style="list-style-type: none">• Check actual values, increase voltage, increase current limit
<ul style="list-style-type: none">• Powder output too high, resulting in insufficient charging of the powder	<ul style="list-style-type: none">• Reduce powder output
<ul style="list-style-type: none">• Excessive total air or triboelectric air volume, resulting in blow-off effects	<ul style="list-style-type: none">• Reduce air settings
<ul style="list-style-type: none">• Insufficient gun distance, resulting in blow-off effects and insufficient charging	<ul style="list-style-type: none">• Check distance and high-voltage values
<ul style="list-style-type: none">• Coating too thick	<ul style="list-style-type: none">• Reduce coating thickness
<ul style="list-style-type: none">• Conveyor runs unsteadily	<ul style="list-style-type: none">• Check conveyor system



Powder falls off after spraying



Poor transport adhesion after curing

Notes

2. Coating

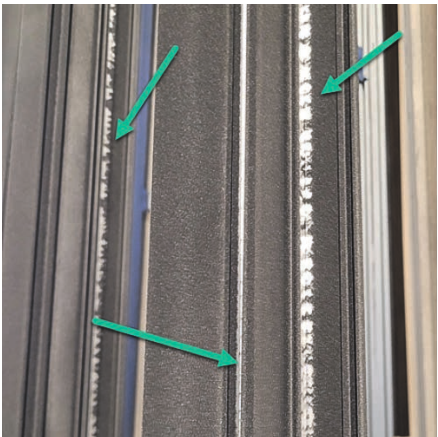
2.3.2 Shedding on inside edges (vertical coating)

Due to overcharging, the powder begins to trickle/fall downward on inside edges during or immediately after coating (causing the powder surface to crack). Primarily on the lower half of the profile.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Excessive electrostatic charge / use of ion-leakage rings	<ul style="list-style-type: none">Use a current limiter (<10 μA) / Remove ion-leakage rings
<ul style="list-style-type: none">Excessive air velocity / spraying distance too small (blow-off effect)	<ul style="list-style-type: none">Ensure a soft spray cloud / increase spraying distance
<ul style="list-style-type: none">Inadequate grounding	<ul style="list-style-type: none">Check grounding / connect profiles at both the top and bottom with clamps



Cracked surface after curing



Cracked surface before curing

Notes



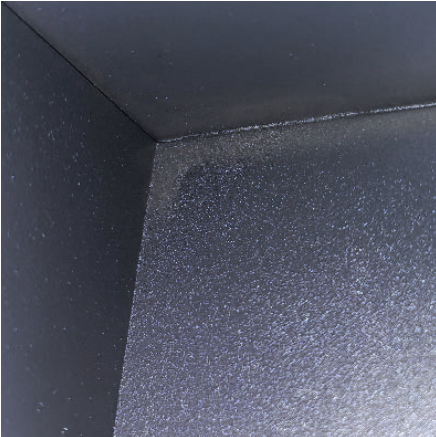
Clumping tendency in powder carton or fluid container

2.4. Clumping tendency in the carton / fluid container

Solid lumps have formed in the powder carton or fluid container.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Incorrect storage (temperature too high)	<ul style="list-style-type: none">• Reduce storage temperature / sieve off powder
<ul style="list-style-type: none">• Incorrect feeding from the powder carton	<ul style="list-style-type: none">• Only switch on the vibration plate if necessary, do not run it continuously
<ul style="list-style-type: none">• The temperature of the fluidizing air is too high	<ul style="list-style-type: none">• Check compressed air
<ul style="list-style-type: none">• Excessive pressure at pumps or pinch valves	<ul style="list-style-type: none">• Check pressure / insert screens
<ul style="list-style-type: none">• Excessive pressure during storage	<ul style="list-style-type: none">• Do not stack powder sacks
<ul style="list-style-type: none">• Powder past its expiry date (stored for too long)	<ul style="list-style-type: none">• Observe expiry date (label), use new powder

Notes



Insufficient coating thickness on inner edges

2.5. Poor penetration behavior into edges and cavities

The coating is not thick enough on inside edges and in cavities, or the powder simply cannot be applied there.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Incorrect air values resulting in blow-off effects	<ul style="list-style-type: none">• Adjust air values, ensure a “soft” powder cloud
<ul style="list-style-type: none">• Excessive powder output	<ul style="list-style-type: none">• Reduce powder output
<ul style="list-style-type: none">• Inadequate grounding	<ul style="list-style-type: none">• Check mounting and grounding
<ul style="list-style-type: none">• Voltage too high / electric field too strong	<ul style="list-style-type: none">• Adjust voltage, set lower current limit, use ion-leakage rings
<ul style="list-style-type: none">• Insufficient spacing between the components	<ul style="list-style-type: none">• Increase spacing
<ul style="list-style-type: none">• Non-coatable structures	<ul style="list-style-type: none">• Adapt structure

Notes

2. Coating

2.6. Coating thickness

2.6.1. Coating too thick

After curing, the powder coating surface is uneven and wavy (orange peel skin) or contains pinholes.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Workpieces are too hot during coating	<ul style="list-style-type: none">• Let parts cool down for longer (approx. 40 °C)
<ul style="list-style-type: none">• Excessive powder output	<ul style="list-style-type: none">• Adjust powder quantity
<ul style="list-style-type: none">• Unfavorable workpiece geometry / mounting (powder remains on horizontal surfaces)	<ul style="list-style-type: none">• Adjust mounting
<ul style="list-style-type: none">• Insufficient gun distance	<ul style="list-style-type: none">• Increase spacing



Excessive coating thickness can lead to orange peel skin

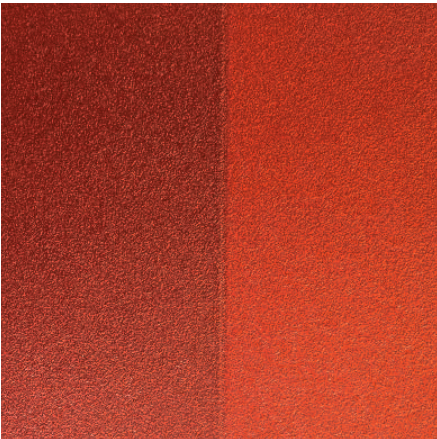
Notes

2. Coating

2.6.2. Coating too thin

The substrate is still visible after curing; granular surface characteristic.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Inadequate grounding	<ul style="list-style-type: none">Clean hook (bare metal) and measure grounding
<ul style="list-style-type: none">Insufficient powder charging	<ul style="list-style-type: none">Increase voltage setting and current limit
<ul style="list-style-type: none">Insufficient powder output	<ul style="list-style-type: none">Increase output, check collector nozzles
<ul style="list-style-type: none">Clogged suction pipes/injectors in powder container	<ul style="list-style-type: none">Check pipes and injectors
<ul style="list-style-type: none">Inadequate tribo charging	<ul style="list-style-type: none">Check powder for triboelectric suitability, increase triboelectric air
<ul style="list-style-type: none">Application equipment (gun, cables, control units, etc.)	<ul style="list-style-type: none">Check guns and cables
<ul style="list-style-type: none">Spraying distance too large	<ul style="list-style-type: none">Reduce distance
<ul style="list-style-type: none">Incorrect hose material	<ul style="list-style-type: none">Select a grounded hose



Shade variation visible after curing



Deposits caused by sintering on the spray nozzle

Notes

2. Coating

2.6.3. Uneven coating thickness

The coating thickness is visibly (or only measurably) uneven.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• With short stroke: irregular gun distance, incorrect stroke adjustment	<ul style="list-style-type: none">• Measure and adjust gun distance, adjust stroke (rule of thumb: stroke = gun distance up to approx. 50 mm)
<ul style="list-style-type: none">• With long stroke: incorrect sine curve	<ul style="list-style-type: none">• Adjust stroke speed and height (if necessary, consult the plant manufacturer)
<ul style="list-style-type: none">• Irregular feed / powder output	<ul style="list-style-type: none">• Check fluidization, powder hoses, and collector nozzles
<ul style="list-style-type: none">• Uneven manual coating	<ul style="list-style-type: none">• Train personnel accordingly
<ul style="list-style-type: none">• Inadequate grounding	<ul style="list-style-type: none">• Clean hook (bare metal) and measure grounding

2.7. Deposits on the spray nozzle

During the coating process, powder or effect additives accumulate on the nozzle slot and then detach and become visible on the coated part after curing. They appear as inclusions or elevations on the cured surface.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Worn nozzle slot	<ul style="list-style-type: none">• Check or change slot
<ul style="list-style-type: none">• Worn nozzle attachment	<ul style="list-style-type: none">• Check or change attachment
<ul style="list-style-type: none">• Excessive powder output	<ul style="list-style-type: none">• Reduce powder quantity
<ul style="list-style-type: none">• With baffle plate: insufficient purge air	<ul style="list-style-type: none">• Adjust purge air settings
<ul style="list-style-type: none">• With effect powder coating: electrostatic charge too high	<ul style="list-style-type: none">• Remove ion-leakage rings
<ul style="list-style-type: none">• With effect powder coating: incorrect powder hose	<ul style="list-style-type: none">• Use grounded hose material

Notes

3. Cured surface

3.1. Spitting on the surface

Local elevations of powder or inclusions of effect additives are visible on the surface.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Insufficient fluidization	<ul style="list-style-type: none">• See 2.1 Fluidization
<ul style="list-style-type: none">• Powder deposits in the powder hose	<ul style="list-style-type: none">• See 2.2 Powder deposits in the powder hose
<ul style="list-style-type: none">• With effect powder coating: incorrect powder hose, causing sintering inside the powder hose	<ul style="list-style-type: none">• Use grounded hose material
<ul style="list-style-type: none">• Deposits caused by sintering on the spray nozzle	<ul style="list-style-type: none">• See 2.7 Deposits on the spray nozzle
<ul style="list-style-type: none">• Uneven powder feeding	<ul style="list-style-type: none">• Adjust conveying and dosing air
<ul style="list-style-type: none">• Conveying/dosing air hose kinked or loose	<ul style="list-style-type: none">• Check the hoses and connection to the control unit/injector



Spitting on the surface



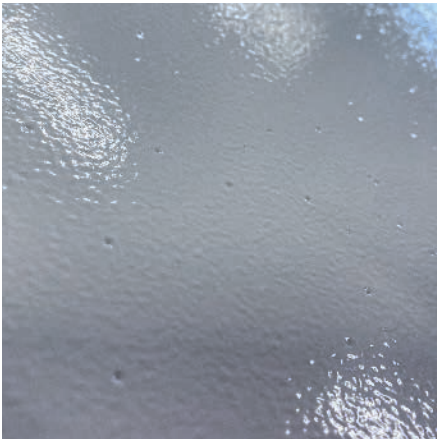
Notes

3. Cured surface

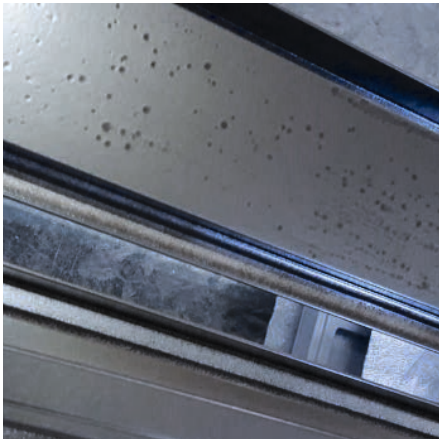
3.2. Cratering

Usually circular flaws on the surface through which the substrate is visible.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Insufficient pretreatment, chemical residues	<ul style="list-style-type: none">Check the parameters, contact the manufacturer
<ul style="list-style-type: none">Silicones/moisture on the surface	<ul style="list-style-type: none">Clean/dry surfaces, check for dripping from the conveyor
<ul style="list-style-type: none">Residues from sprays, creams, etc.	<ul style="list-style-type: none">Test/replace products
<ul style="list-style-type: none">Contaminated coating plant	<ul style="list-style-type: none">Thoroughly clean the plant
<ul style="list-style-type: none">Carryover from other powder coatings	<ul style="list-style-type: none">Thoroughly clean the plant
<ul style="list-style-type: none">Outgassing (from substrate/powder coating, etc.)	<ul style="list-style-type: none">Temper the component, observe curing parameters
<ul style="list-style-type: none">Overcoating putty and wet coatings	<ul style="list-style-type: none">Check for suitability, temper component
<ul style="list-style-type: none">Oil in ambient air/compressed air	<ul style="list-style-type: none">Check filters
<ul style="list-style-type: none">Clean the first coat with solvent	<ul style="list-style-type: none">Temper component, allow solvent to evaporate



Visible substrate on coated surface due to cratering



Notes

3. Cured surface

3.3. Pinholes

Ultra-fine holes (pores) in the coating surface with a significant local reduction in surface gloss.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Curing temperature/heating rate too high	<ul style="list-style-type: none">• Increase heating up-time, lower curing temperature
<ul style="list-style-type: none">• Moisture content of powder coating too high	<ul style="list-style-type: none">• Check storage conditions, dry the powder
<ul style="list-style-type: none">• Overcharging of the powder	<ul style="list-style-type: none">• Reduce coating thickness/voltage, use current limiter
<ul style="list-style-type: none">• Air inclusions/outgassing	<ul style="list-style-type: none">• Temper, adjust curing conditions
<ul style="list-style-type: none">• Insufficient pretreatment, chemical residues	<ul style="list-style-type: none">• Check the parameters, contact the manufacturer

3.4. Picture frame effect

Visible change in the surface finish around the edges.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• High voltage, spray current too high	<ul style="list-style-type: none">• Reduce voltage, limit current
<ul style="list-style-type: none">• Excessive wrap-around	<ul style="list-style-type: none">• Adjust high voltage, gun distance, and total air
<ul style="list-style-type: none">• Excessive feed/coating or over/under-running of the guns	<ul style="list-style-type: none">• Adjust settings to suit the respective workpieces or hangers
<ul style="list-style-type: none">• For fine-structure powder coatings: inconsistent separation	<ul style="list-style-type: none">• Use current limiter, use ion-leakage rings



Pinholes in coating surface

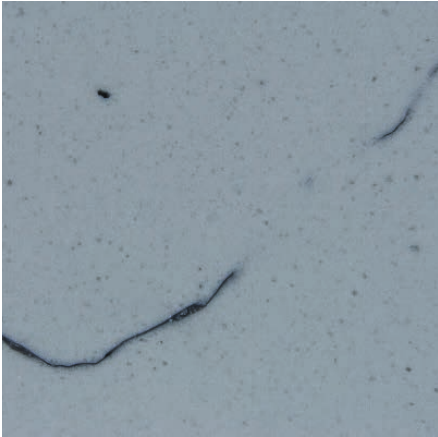


Picture frame effect at edges

3. Cured surface



General contamination



Contamination from fibers

3.5. General impurities

Impurities or inclusions are visible on the cured surface

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Deposits released by the cyclone	<ul style="list-style-type: none">• Check cyclone for sintering, clean to remove granules
<ul style="list-style-type: none">• Dirt sucked into the booth during reclaiming	<ul style="list-style-type: none">• Ensure clean room air, use screens during reclaiming
<ul style="list-style-type: none">• Dirt from the environment	<ul style="list-style-type: none">• Pay attention to cleanliness
<ul style="list-style-type: none">• Residual powder from color change still in circulation	<ul style="list-style-type: none">• Clean booth and powder circuit more thoroughly; observe the plant manufacturer's specifications
<ul style="list-style-type: none">• Fibers from cleaning cloths, work clothes, etc.	<ul style="list-style-type: none">• Use suitable cleaning materials, if possible use lint-free work clothing

Notes

3. Cured surface

3.6. Blisters

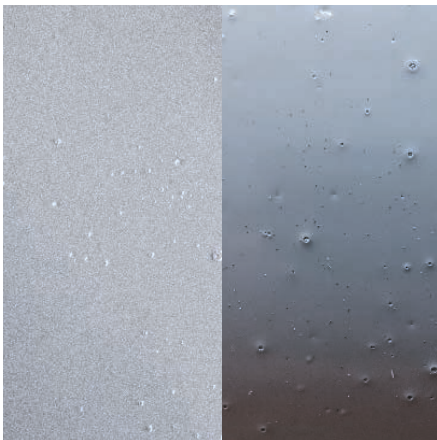
Visible blisters or large craters caused by burst bubbles in the cured coating film.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Water/oil under the coating layer	<ul style="list-style-type: none">• Dry/clean workpieces thoroughly
<ul style="list-style-type: none">• Outgassing from the substrate	<ul style="list-style-type: none">• Ensure proper galvanization/pretreatment, temper workpieces, use outgassing-friendly powder coatings
<ul style="list-style-type: none">• Overcoating putty and wet coatings	<ul style="list-style-type: none">• Check for suitability, temper component
<ul style="list-style-type: none">• For blasted parts: failure to degrease before blasting	<ul style="list-style-type: none">• First degrease, then blast

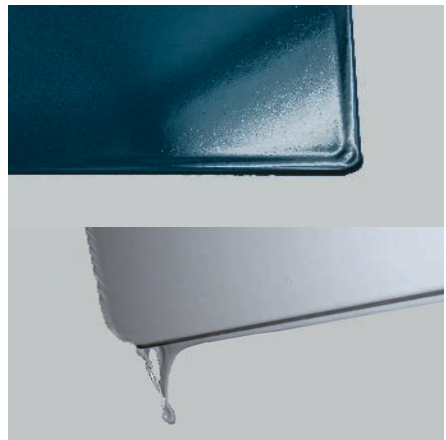
3.7. Edge and droplet formation

Thick edges or even droplets can form on the edges of workpieces.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Coating too thick	<ul style="list-style-type: none">• Reduce coating thickness
<ul style="list-style-type: none">• Excessive temperatures/heating rates	<ul style="list-style-type: none">• Check oven temperature
<ul style="list-style-type: none">• Workpiece temperature too high	<ul style="list-style-type: none">• Allow to cool sufficiently
<ul style="list-style-type: none">• Workpiece edges too sharp	<ul style="list-style-type: none">• Deburr edges



Blistering on the cured coating film



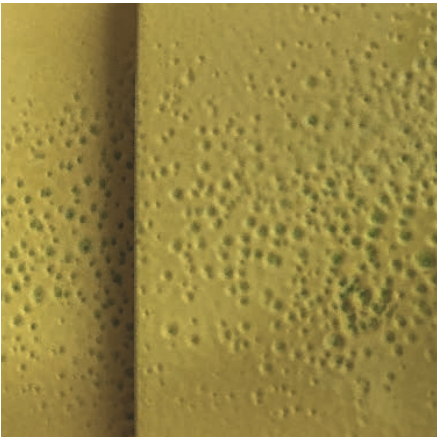
Thick edges or droplets on the edges

3. Cured surface

3.8. Wetting impairments

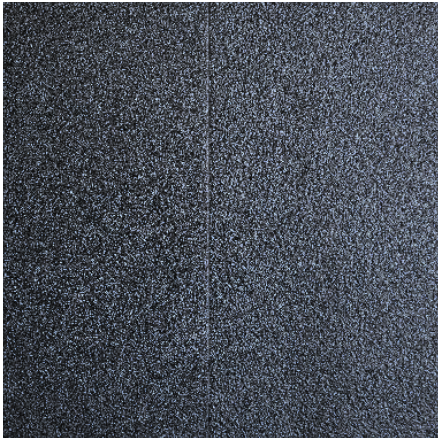
Insufficient adhesion of the powder during coating; tearing of the powder coating during melting and lack of adhesion to the substrate of the cured component.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Insufficient pretreatment	<ul style="list-style-type: none">Check pretreatment and rinsing parameters, avoid interruptions
<ul style="list-style-type: none">Carried over oil/grease	<ul style="list-style-type: none">Ensure pretreatment baths are clean
<ul style="list-style-type: none">Contaminated workpiece surface	<ul style="list-style-type: none">Only touch pretreated workpieces with clean gloves
<ul style="list-style-type: none">Retention time in the oven is significantly too long	<ul style="list-style-type: none">Observe curing parameters



Wetting impairments due to insufficient adhesion of the powder

Notes



Irregular fine structure

3.9. Irregular fine structure

The structure is not fine and uniform; the surface appears “slushy”; visible streaks and cloud formation on the surface.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Coating too thick	<ul style="list-style-type: none">• Reduce coating thickness
<ul style="list-style-type: none">• Excessive electrostatic charge	<ul style="list-style-type: none">• Reduce voltage, set lower current limit; recommendation: use ion-leakage rings
<ul style="list-style-type: none">• Uneven powder output	<ul style="list-style-type: none">• Check fluidization, air settings
<ul style="list-style-type: none">• In case of streaks: insufficient spraying distance	<ul style="list-style-type: none">• Increase spraying distance

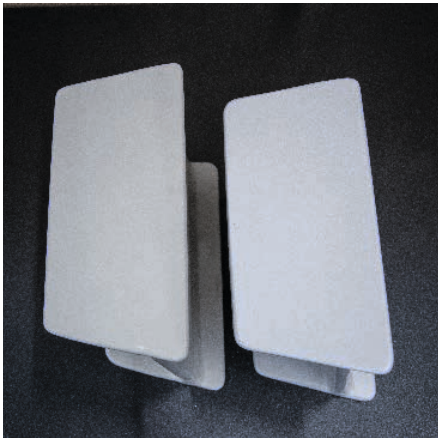
Notes

4. Surface characteristic

4.1. Color deviations (uni-color shades)

Deviating shades on the component itself or in comparison to the master sample/standard.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Coating too thin (substrate visible)	<ul style="list-style-type: none">• Increase coating thickness
<ul style="list-style-type: none">• Over-curing of the surface	<ul style="list-style-type: none">• Observe correct curing conditions; perform oven measurement
<ul style="list-style-type: none">• Different curing conditions	<ul style="list-style-type: none">• Pay attention to the respective curing conditions
<ul style="list-style-type: none">• Materials of differing thickness in the oven at the same time	<ul style="list-style-type: none">• Check hangers and oven settings
<ul style="list-style-type: none">• Workpieces pretreated incorrectly (stains on the substrate)	<ul style="list-style-type: none">• See 1.1 Pretreatment of aluminum
<ul style="list-style-type: none">• Metamerism (influence of light on color perception)	<ul style="list-style-type: none">• Perform assessment under indirect sunlight, use daylight lamps (D65)
<ul style="list-style-type: none">• Fluctuating gloss levels (visually darker shade)	<ul style="list-style-type: none">• See 4.4 Fluctuating gloss levels
<ul style="list-style-type: none">• In case of yellowing: directly heated gas oven	<ul style="list-style-type: none">• Use indirectly heated oven
<ul style="list-style-type: none">• Different substrate base colours when recoating	<ul style="list-style-type: none">• Ensure a uniform substrate or remove the old paint beforehand
<ul style="list-style-type: none">• Contamination with other powders	<ul style="list-style-type: none">• Clean system thoroughly, use fresh powder



Color deviations in uni-color shades



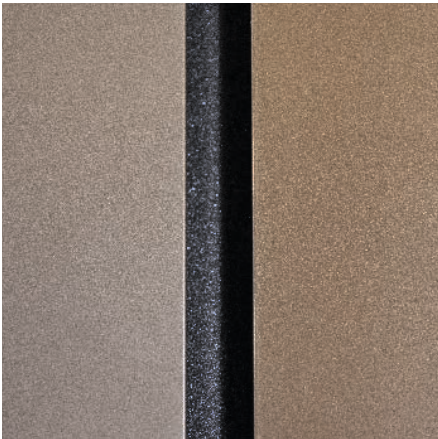
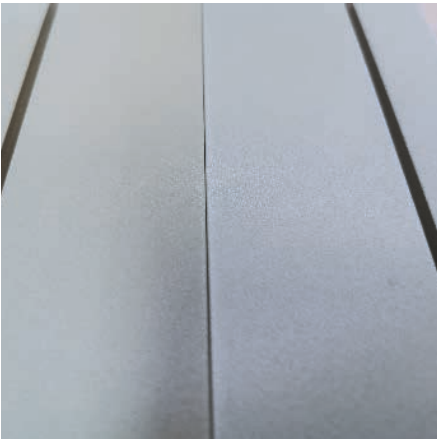
4. Surface characteristic

4.2. Color deviations (effect powder coatings)

4.2.1. Color deviations compared to the master sample/color chart

The shade of the workpieces differs visibly from that of the master samples or color charts.

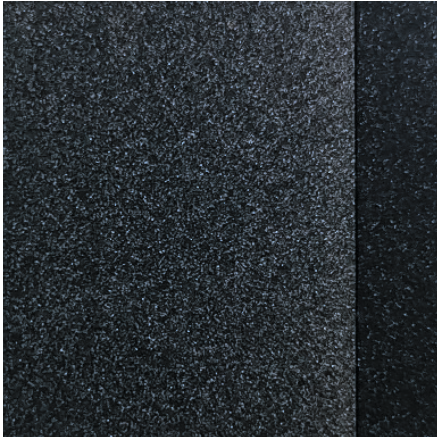
Likely cause	Recommended solutions
<ul style="list-style-type: none">• Batch variation	<ul style="list-style-type: none">• Use only powder from one batch per job, for master samples use powder from the same batch
<ul style="list-style-type: none">• Different application parameters	<ul style="list-style-type: none">• Make a note of the settings and use them for subsequent coating, use IGP-Effectives®
<ul style="list-style-type: none">• Excessive or incorrect proportion of reclaimed powder	<ul style="list-style-type: none">• Increase fresh powder content, coat without reclaiming
<ul style="list-style-type: none">• Different coaters/plants	<ul style="list-style-type: none">• Use one system/coater only per job, use IGP-Effectives®
<ul style="list-style-type: none">• Inadequate grounding	<ul style="list-style-type: none">• Clean hooks (bare metal), measure grounding
<ul style="list-style-type: none">• Incorrect spraying distance	<ul style="list-style-type: none">• Follow recommendations in the processing guideline



Color deviations in effect powder coatings

Notes

4. Surface characteristic



Color deviations due to effect variations

4.2.2. Fluctuating effects

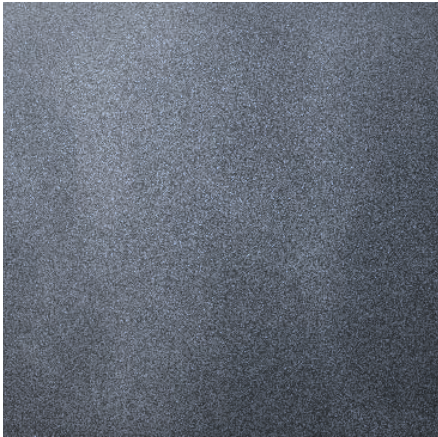
Fluctuations in the effect formation on the workpiece itself or between individual workpieces.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Changed high voltage/electrostatic charge	<ul style="list-style-type: none">• Use the same settings, coat exclusively with or without ion-leakage rings
<ul style="list-style-type: none">• Inconsistent fresh powder dosage	<ul style="list-style-type: none">• Automated dosing of fresh and reclaimed powder
<ul style="list-style-type: none">• Coating started with fresh powder; reclaimed powder used for subsequent coating	<ul style="list-style-type: none">• Before the start of coating, convey a small amount of powder through the reclaiming system and add it to the fresh powder
<ul style="list-style-type: none">• Uneven manual coating	<ul style="list-style-type: none">• Train personnel accordingly; perform manual pre-coating
<ul style="list-style-type: none">• If there is a color difference between the front and back of profile sections: spraying distance is too small, powder output is too high	<ul style="list-style-type: none">• Increase distance and reduce powder quantity
<ul style="list-style-type: none">• Irregular powder feeding	<ul style="list-style-type: none">• See 2.1 Fluidization and 2.2 Powder deposits in the powder hose; check for a “soft cloud”
<ul style="list-style-type: none">• Feeding from supply container / carton	<ul style="list-style-type: none">• Use a fluid container
<ul style="list-style-type: none">• Separation of powder and effect additives	<ul style="list-style-type: none">• Reduce high voltage, reduce total air volume
<ul style="list-style-type: none">• Deposited/sintered powder on the electrode	<ul style="list-style-type: none">• Check purging air

4. Surface characteristic

4.2.3. Streaking and cloud formation
Visible streaks and/or cloudy irregularities in the effect formation.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Insufficient spraying distance	<ul style="list-style-type: none">• Increase spraying distance
<ul style="list-style-type: none">• Excessive powder output	<ul style="list-style-type: none">• Reduce powder output, check for "soft cloud"
<ul style="list-style-type: none">• Uneven follow-up coating	<ul style="list-style-type: none">• Train personnel accordingly; perform manual pre-coating
<ul style="list-style-type: none">• Total air volume too high	<ul style="list-style-type: none">• Increase spray distance, check for "soft cloud"
<ul style="list-style-type: none">• Inadequate grounding	<ul style="list-style-type: none">• Clean hook (bare metal) and measure grounding
<ul style="list-style-type: none">• With long stroke: incorrect sine-curve settings	<ul style="list-style-type: none">• Adjust stroke height/speed and conveying speed in accordance with gun distance (check with plant manufacturer)
<ul style="list-style-type: none">• Defective gun	<ul style="list-style-type: none">• Check the coating plant, measure voltage
<ul style="list-style-type: none">• Feeding from supply container/carton	<ul style="list-style-type: none">• Use a fluid container
<ul style="list-style-type: none">• Excessive purging air/gun air	<ul style="list-style-type: none">• Reduce purging air/gun air



Visible streaks and/or cloudy irregularities

4. Surface characteristic

4.3. Lack of opacity

After coating, the substrate is still visible.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Coating too thin	<ul style="list-style-type: none">Increase coating thickness, observe minimum coating thickness
<ul style="list-style-type: none">With long stroke: incorrect sine-curve settings	<ul style="list-style-type: none">Adjust stroke height/speed and conveying speed in accordance with gun distance (check with plant manufacturer)
<ul style="list-style-type: none">With short stroke: irregular gun distance, incorrect stroke adjustment	<ul style="list-style-type: none">Measure and adjust gun distance, adjust stroke (rule of thumb: stroke = gun distance up to approx. 50 mm)
<ul style="list-style-type: none">Natural color of the substrate (brass, steel, aluminum)	<ul style="list-style-type: none">Increase coating thickness
<ul style="list-style-type: none">Surface of the substrate visible (sanding, blasting)	<ul style="list-style-type: none">Reduce surface roughness, prepare surface more evenly

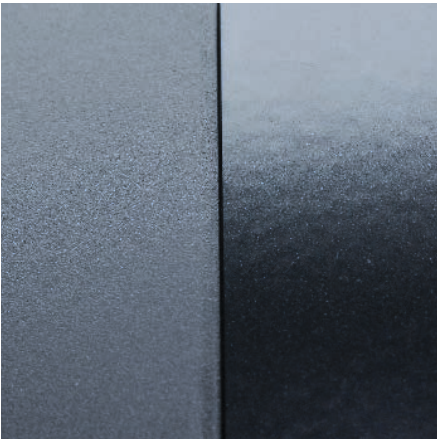
Notes

4. Surface characteristic

4.4. Fluctuating gloss levels

Differences in the level of measured or visible surface gloss on a workpiece or in comparison to other workpieces.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Incorrect curing conditions (powder over/under-cured)	<ul style="list-style-type: none">Check curing window, perform oven measurement
<ul style="list-style-type: none">Materials of very different thickness in oven at same time	<ul style="list-style-type: none">Adjust hangers, perform oven measurement
<ul style="list-style-type: none">Powder stored for too long or at an excessively high temperature	<ul style="list-style-type: none">Improve storage conditions, use new powder
<ul style="list-style-type: none">Reclaimed portion too large	<ul style="list-style-type: none">Increase fresh-powder content
<ul style="list-style-type: none">High voltage too low / insufficient charge	<ul style="list-style-type: none">Increase voltage, set current limiter to higher value
<ul style="list-style-type: none">Excessive / irregular coating thickness	<ul style="list-style-type: none">Reduce coating thickness



Differences in measured or visible surface gloss on coated workpieces

Notes

5. Film properties

5.1. Mechanical properties

5.1.1. Cracking, chipping of the surface

The values specified in the data sheet for ball impact, cupping test or mandrel bend test are not achieved.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Incorrect oven settings (coating over/under-cured)	<ul style="list-style-type: none">Check curing window, perform oven measurement
<ul style="list-style-type: none">For multi-layer construction: incorrect process	<ul style="list-style-type: none">Observe the applicable processing guideline
<ul style="list-style-type: none">Insufficient pretreatment	<ul style="list-style-type: none">Check pretreatment parameters

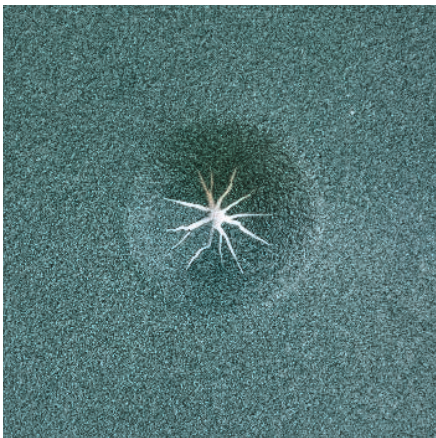
Notes

5. Film properties

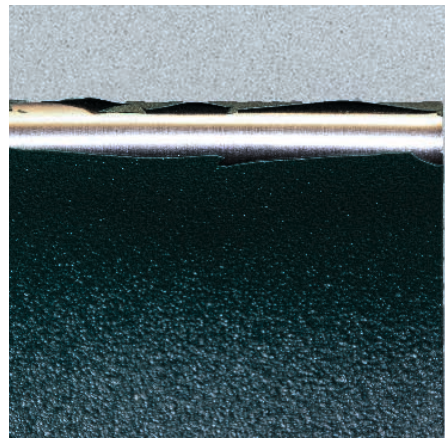
5.1.2. Flaking, peeling of the coating layer

The coating film detaches from the substrate by itself or under mechanical stress.

Likely cause	Recommended solutions
<ul style="list-style-type: none">• Incorrect oven settings (coating over/under-cured)	<ul style="list-style-type: none">• Check curing window, perform oven measurement
<ul style="list-style-type: none">• For multi-layer construction: incorrect process	<ul style="list-style-type: none">• Observe the applicable processing guideline
<ul style="list-style-type: none">• Absence of primer	<ul style="list-style-type: none">• Observe the specifications in the technical data sheet
<ul style="list-style-type: none">• Oils/grease/release agents on the surface	<ul style="list-style-type: none">• Thoroughly clean/pretreat the surface
<ul style="list-style-type: none">• Rust/dust on the surface	<ul style="list-style-type: none">• Thoroughly clean/pretreat the surface
<ul style="list-style-type: none">• For laser-cut parts: lack of pretreatment of the cut edges	<ul style="list-style-type: none">• Mechanically process laser-cut edges (grind, blast)
<ul style="list-style-type: none">• For aluminum: lack of pretreatment (insufficient pickling removal, inadequate degreasing)	<ul style="list-style-type: none">• Increase pickling removal > 1.5 g/m², improve degreasing
<ul style="list-style-type: none">• Primer fully cured	<ul style="list-style-type: none">• Only allow primer to gel, observe applicable processing guideline
<ul style="list-style-type: none">• In case of intermediate adhesion loss: directly heated gas oven	<ul style="list-style-type: none">• Use indirectly heated gas/electric oven
<ul style="list-style-type: none">• Excessively long storage before overcoating	<ul style="list-style-type: none">• Carry out overcoating within 24 hours



Chipping on coating layer



Peeling of the coating layer

5. Film properties

5.2. Other properties

5.2.1. Conductive properties

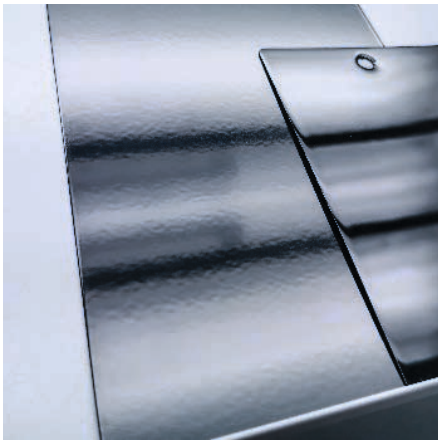
The surface resistance is too low / too high.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Coating thickness too low/high	<ul style="list-style-type: none">Increase/reduce coating thickness
<ul style="list-style-type: none">Incorrect measuring method	<ul style="list-style-type: none">Perform measurement to DIN EN 61340-2-3, perform measurement with electrodes, maintain electrode distance
<ul style="list-style-type: none">Incorrect powder coating	<ul style="list-style-type: none">Use conductive powder coating (11th digit: "C"), example: 331SA70350C00

5.2.2. Flow

The surface appears wavy and is not smooth.

Likely cause	Recommended solutions
<ul style="list-style-type: none">Incompatibility with other powders	<ul style="list-style-type: none">Clean plant / use fresh powder
<ul style="list-style-type: none">Coating too thick	<ul style="list-style-type: none">See 2.6.1 Coating too thick
<ul style="list-style-type: none">Insufficient pretreatment	<ul style="list-style-type: none">Adjust pretreatment parameters / contact manufacturer



Surface appears wavy

Notes

6. Keyword index

	Term	Explanation
A	Abrasion resistance	The coating film is not scratched due to mechanical stress (by cardboard, paper, etc.)
	Accumulation	Powder accumulation in or around the coating booth or on the workpiece
	Additive	Agent added to the powder coating to adjust or improve its properties
	Adhesion strength (adhesion)	Describes the adherence of one material to another; during coating, the adhesion of the coating film to the substrate
	Adhesion water dryer	Oven for drying of the workpieces after pretreatment
	Anodizing	Anodic oxidation of the aluminum substrate, similar to the anodizing process but without compression; for optimal corrosion protection
	Application	Process of applying a powder coating to the workpiece by means of coating equipment; can be automated or manual
B	Bimetallic corrosion	Results from the use of different types of metals
	Binder	A primary component of the coating; usually polyester, epoxy, acrylic or mixtures of these
	Blister	Sealed elevation in the powder coating film caused by outgassing
	Blooming	A typically white film on the cured coated surface that can be wiped away
	Buchholz hardness	Standardized test method for measuring surface hardness in accordance with DIN EN ISO 2815
C	Chalking	Decomposition and fading of the coated surface due to weathering
	Charging	Electrostatic charging of particles or powder via corona or tribo charging
	Cloud formation	Local cloud-like irregularities in the effect formation in metallic powder coatings
	Coating film	Sealed coating layer on the component after curing

6. Keyword index

Coating thickness/density	Measurable thickness of the coating on the substrate
Color change	Cleaning of the entire coating plant to allow subsequent coating with a different color
Color deviation	Difference in shade between sample and component or between different components
Color standard	Color shade as standardized by institutions (RAL, NCS, Pantone, etc.)
Color/shade	The visual characteristic of a surface, independent of gloss and structure
Contamination	Undesirable substances (dust, fibers, etc.) in the coating plant and powder coating
Conveying air	Supply air in the injector that is used to regulate the powder quantity; in plants with total air control it is regulated automatically depending on the set powder quantity
Conveyor/conveyor chain	System that moves the component or the suspension trolley through the coating plant
Corrosion	Reaction between metal and oxygen accelerated by the presence of salt, water or intense heat
Crack	Visible breakage of the coating film, usually caused by insufficient cross-linking
Cratering	Flaw in the powder coating caused by tearing of the powder coating during the curing process or a burst blister
Cross-linking	Curing of the powder coating during the retention time in the oven
Cyclone	System within the powder circuit that separates the overspray powder from the extracted air
D Deaeration additive	Powder additive used to avoid blisters or similar on outgassing substrates
Deburring	Rounding of cut edges with a minimum radius of 2 mm
Dip pretreatment	Chemical pretreatment method in which the parts are immersed in a bath filled with chemicals
Dosing air	Supply air in the injector for regulation and homogenization of the powder feeding in the powder hose; this is regulated automatically in plants with total air control

	Downtime	Unwanted shutdown of the system due to malfunctions or troubleshooting
	Duroplast	Plastic or coating that cannot be deformed again after cross-linking, even at high temperatures
	DW rinsing	Rinsing with demineralized water (conductivity max. 20 µs/cm) during pretreatment
E	Edge crawling	Withdrawal of the powder from the edges during melting; insufficient coating thickness at the edges
	Edge structure	Accumulation of powder on the outer edges of the workpieces
	Electrogalvanizing	Chemical application of a zinc layer on the component as corrosion protection; the zinc layers are thinner than those created via hot dip galvanizing
	Electrostatic charge	Electrical charge generated by the high voltage at the coating gun, and the associated charging of the powder
	End filter	Fine filter for particles that were not separated by the cyclone
	Etching	Chemical removal of oxide layers, rust or scale from the metal surface
	Etching slurries	Slurries produced by the etching process
F	Faraday cage	Electrostatic phenomenon that makes coating in cavities and inner edges difficult
	Filiform corrosion	Thread-like corrosion of aluminum; especially prevalent on damaged areas of the coated surface or cut edges in the presence of air with a high salt content
	Fine fraction	Proportion of fine powder grains (<10 µm) in the powder coating
	Flaking	The cured coating film detaches from the workpiece at low load
	Flow	Describes the smooth surface characteristics of the coating film
	Fluidizing	The powder is brought into a “liquid/suspended” state by means of compressed air
	Fluidizing bed	A fluid container that has a fluidizing membrane at the bottom, through which the fluidizing air can flow into the container or powder

6. Keyword index

	Foaming	Planar, fine-pored blistering due to greatly increased coating thickness or heating up too quickly
	Formation of droplets	During melting, the powder coating runs off the edges of the workpiece in the form of droplets
	Fresh water rinsing	Rinsing cycle with fresh tap water to remove chemical residues during pretreatment
G	Galvanizing	Application of a zinc layer on steel as corrosion protection
	Glass transition point (T _g)	Temperature range in which the powder begins to soften
	Gloss	Ability of a surface to reflect incoming light
	Gray film	Optically visible decomposition products or deposits on the cured powder coating film, which can be wiped away
	Grounding	Conductive electrical connection between components or the coating object and the ground connection; measurement and resistance values in accordance with EN 50177
H	Hangers	Frame, rod, or rail for mounting of the workpieces to be processed
	Heating rate	The time in which the workpiece is heated in the oven from the ambient temperature to the required object temperature
	High-voltage blowback	Star-shaped defects in the uncured coating film due to a lack of grounding
	Hot-dip galvanizing	Zinc coating applied via a dipping process as corrosion protection
I	Incompatibility	Impairment of the coating surface caused by other substances/powders in the coating layer
	Infiltration	Penetration of water and oxygen between the substrate and the coating layer, and the resulting corrosion
	Injector	Compressed-air-operated device used to feed the powder from the container through the powder hose
	Intercoat adhesion	Adhesion between two coating layers in a multilayer structure
L	Leakage resistance	Describes the measured resistance between the workpiece surface and the ground connection

6. Keyword index

M

Loosening	Softening of the coating surface due to solvents or temperature
Lumps	Solid lumps of powder, which may be caused by pressure, temperature or vibration
Maintenance	Regular servicing of all system components by the manufacturer
Material thickness	Thickness of the substrate to be coated
Mechanical properties	Measurable properties of the coating surface via standardized mechanical tests for flexibility, adhesion, etc., (e.g., Erichsen cupping, ball impact, mandrel bend test, etc.)
Metallic effects	Powder coatings with added metallic pigments
Metallic pigments	Effect pigments added to the powder coating to achieve special surface characteristics: mica, chrome effects, etc.
Metamerism	Differing perception of the same color caused by different light sources

N

Nozzle	Attachment for the coating gun, available in different versions, usually flat spray or baffle-plate nozzles
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O

Object temperature	Temperature that the component must reach in the oven to ensure proper curing; the retention time starts when this temperature is reached
Opacity	Ability of the coating to mask the shade of the substrate with the intrinsic color of the coating
Orange peel skin	Visible, wave-shaped interference pattern on the coated surface
Outgassing	After curing: visible blisters/cratering or pinholes in the surface; caused by gases that have migrated through the coating film during curing
Oven	Device used for heating or cross-linking of the powder by means of different energy sources (electric, gas, oil, infrared)
Oven graph	Recording of the temperature curve in the oven
Over-curing	Curing of the workpiece in the oven at an excessively high curing temperature or for an excessively long retention time
Overcoating	Coating a previously coated substrate

P

Oversize particles	Powder particles that are larger than the desired particle distribution and are screened out
Overspray	Excess powder coating that is sprayed but did not adhere to the workpiece during the coating process
Oxide layer	Sealed corrosion layer on a metallic substrate
Particle distribution	Indicates the ratio between the sizes of the individual powder grains
Penetration behavior	Describes the penetration of the coating powder into inner edges, cavities, and recesses during the coating process
Picture frame effect	Visible surface deviation (gloss, flow, structure formation) around the edges of a component
Pigment	Material used to color the powder coating
Pinholes	Fine-pored impairment of the cured coating film due to outgassing or overcharge effects
Powder center	Component of the fresh-powder feeding system, which includes the powder/fluid container and the injectors
Powder circuit	Powder that is not deposited on the workpiece is collected and conveyed back into the powder container to be resprayed
Powder feeding	Transport of the powder from the container to the gun or from the reclaiming system back into the container
Powder hose	Hose through which the powder-air mixture is transported from the injector to the coating gun
Powder puffs	Powder lumps on the coating layer, caused by deposits that have detached, for example, from the spray nozzle
Pre-anodizing	See Anodizing
Pretreatment	(Chemical or mechanical) cleaning and passivation of the substrate
Purging air	Air used to clean the electrode in flat spray nozzles and the baffle plate in baffle-plate nozzles

R

Reclaiming	Operating mode of coating plants that makes it possible to reuse overspray powder in the coating process
Resistance	Imperviousness of the coating to mechanical, chemical, physical or weather influences

S

Retention time	Time during which the workpiece remains in the oven after it has reached the required object temperature
Reversal point	Turning point of automatic guns during the up and down movement
Runners	Nose or droplet-shaped drainage pattern on the coating during the melting process
Rust	Colloquial term for corrosion on iron or steel parts
Sanded area	Visible impairment of the coating film due to mechanical pretreatment of the substrate, e.g., sanding
Screen/screening machine	System used to sieve the powder coating; also possible with ultrasound
Separating agent	An agent used in the production of injection-molded parts to prevent sticking in the mold
Shedding	Powder trickles/falls in small quantities from the workpiece; no laminar detachment occurs
Sieve analysis	Simple method for rough determination of the powder-particle size
Sine wave pattern	Pre-configured movement of the coating guns over the component in accordance with the conveying speed, gun distance, and stroke speed
Sintering	Solid deposits on hoses, nozzles, or other plant components
Solvent resistance	Imperviousness of the cured coating film to changes caused by applied solvents
Specks	Inclusion of visible, non-meltable dirt particles in the coating film
Spitting	See Powder puffs
Spots	Visible elevations on the coating surface
Spray pretreatment	Chemical pretreatment in which the chemicals are applied by spraying
Streaking	Elongated irregularities in the coating thickness or the effect appearance of metallic powder coatings
Structure	Visible, non-smooth surface characteristic
Substrate	Material of the workpiece to be coated, e.g. steel, aluminum, wood, plastic

T	Surface defect	Visible defects in the coating film
	Susceptibility to scratches	Inability of the coating film to withstand friction or scratches
	Sweep blasting	Special, gentle blasting process for galvanized substrates
	Tempering	Preliminary heating of outgassing substrates
	Thermoplastic	Deformable plastic or coating that becomes soft again at high temperatures
	Transport adhesion	Adhesion of the powder to the substrate before curing
	Tribo charging	Powder particles are positively charged by friction on Teflon (PTFE)
V	Visible surface performance	The area each gun in the system coats per minute, calculated based on the stroke height, number of guns, and conveying speed. Recommendation: $< 1 \text{ m}^2/(\text{min} \times \text{gun})$
	Voltage	Electrical energy applied to the electrode of the coating gun
W	Welding point	Defect visible through the coating film due to welding of the substrate
	Wetting	Planar flow of a liquid or molten powder coating on a surface
	Wrap-around	Coating of the back of the workpiece due to electrostatics
Y	Yellowing	Change of shade into the yellow range due to temperature, oven, or weather conditions

The right powder coatings and settings.

Benefit from the decades of experience behind IGP Powder Coatings to ensure you get excellent results from your powder coating.

We look carefully at your goals and find new solutions to help you achieve perfect coatings. Choose the components from our service package that suit you. If you have specific questions, our experts can visit your company and support you with on-site technical advice.



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Training programs for efficient handling of powder coatings.

Well-trained employees are a strategic success factor for every company. For this reason, IGP offers education and training for our customers.

Our comprehensive training program teaches efficient handling of high-quality powder coatings to professionals of all experience levels. From the basics to specific technical content, it offers everything necessary to ensure reliable processing of IGP products and the fulfillment of challenging quality requirements.

Find the right training course for your employees and your company.



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The information and illustrations in this brochure are valid at the time of printing. IGP Powder Coatings reserves the right to make any necessary changes at any time and without prior notice. IGP innovations are protected by patents.

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