Product Advantages and Premises Using Precoated Sheet Metal for CPP-Systems“

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Canon
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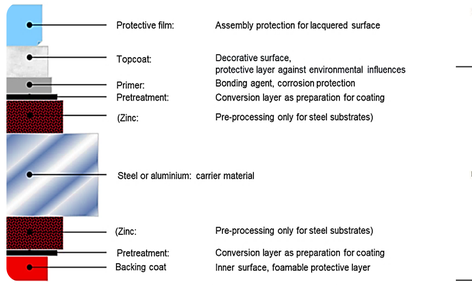
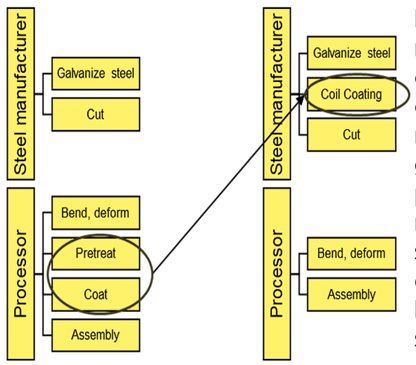
THEORETICAL FOUNDATIONS

What are precoated sheet metals?

“Finish first – fabricate later” - This principle already provides an overview of the technology on which “coil-coating” is based on. Basically, in this finishing process, the coils, mostly consisting of steel- or aluminum strips, are organically coated by thermoset coating layers. This is done by rolling on the coils and firing them in continuous ovens afterwards. In general, coil coating is a composite of a metallic carrier material and an organic coating. Subsequently, they will be wound up again for further processing. In accordance with the slogan at the beginning, the sheet metal is first lacquered and then processed.



Jandel, A.-S. and Meuthen, B. (2013) Coil Coating: Bandbeschichtung: Verfahren, Produkte und Märkte



It is now the task of the steel manufacturer to ensure that the coating will not be damaged, and that the performance will not be impaired. This is guaranteed by adapting the parameters of the coil-coated materials as required. The substrate and the coating are only two of many causes which have an influence on the surface quality.

PROPERTIES

Although the manufacturer is responsible for the quality of the coating, the final properties will be influenced by the further processing. The coating technology is a complex interplay between several parameters, comprising chemical, physical, processing, environmental, toxic, and economic variables. Therefore, this technology can only be fully comprehended if the properties of the coating material and the object that has to be coated are known, too. Additionally, the quality shaping variables, including economic and environmental specifications, should be addressed.

Properties	Coating[1]				Coating[1]					
	EP	SP	PUR	PUR-PA	HDP	HDP-PA	PVDF	PVC(P)	PVC(F)	SP-PET(F)
	Epoxy	Polyester	Polyurethane	Polyamide-modified PUR	High-Durability Polyester	Polyamide-modified HDP	Polyvinylidene fluoride	Polyvinyl chloride plastisol	Polyvinyl chloride	Co-laminate
Coating thickness[2] [µm] not including adhesive film for film coatings	10 (3–20)	25 (5–60)	25 (10–60)	25 (10–50)	25 (25–60)	25 (15–50)	35 (20–60)	100–200 (40–200)	100–200 (50–800)	35–65 (35–65)
Specular gloss	10–50	10–80	10–80	10–40	20–80	10–40	20–40	45–70	5–15	20–80
Max. heat resistance °C	80	80	80	80	80	80	110	60	60	80
Surface hardness										
Formability/bending (T-bend)										
Formability/roll forming										
Formability/deep drawing										
Abrasion resistance										
Resistance to weathering, UV resistance										
Resistance to weathering, corrosion resistance										

[1] The abbreviations have been selected in conformance with DIN EN 10169 or its meaning.
[2] The initial value gives the usual coating thickness. The range of coat thickness that is technically feasible is shown in parentheses. Additional temporary protective films are not included.
The other properties are based on the respective usual coating thickness of the coating.

Excellent
Very good
Good
Satisfactory
Sufficient
Unusable or inappropriate

Stahl-Informations-Zentrum (2013) ‘Organisch bandbeschichtete Flacherzeugnisse aus Stahl’

PROCESSING

Main group	General information	Production process	Special feature
Cutting	o Avoidance of excessive processing speeds o Tools must be designed to suit the material (reduce friction) o The sheet should be machined from the coated side (visible side) of the end product. For thick coatings or for foils, cutting should be from the revere side	Punching Cutting Slitting	o Tools are contaminated by paint chips and buildup
		Laser cutting	o Use of nitrogen o The property of adhesion between the film and the cover layer should be good enough to avoid detachment and not cause interference with the laser beam
		Waterjet cutting	
Forming	o Larger forming radii, lower forming speeds and higher processing temperatures around the glass transition temperature facilitate forming o The total coating thickness, consisting of substrate and metallic coating, the lacquer and an optional protective film, must be taken into account o By polishing the tools or using suitable lubricants, e.g. essential oil, the coefficient of friction can be reduced to below 0.05 for steel tools o A film to protect the paint surface should be used (especially for bending)	Deep drawing	o The clearances between the punch and die should always be equal to the total thickness of the sheet (tolerance of about plus 5 to 10 %)
		Roll forming	o The diameter of the rollers should be as large as possible, all sharp edges should be eliminated and replaced with fillets
		Flap bending	
		Die bending / folding	o With respect to the die, in principle the width (W) should be six to twelve times higher than the material thickness (D)
		Embossing bending	
		Panel forming	
		Spinning	o A large diameter roller with a polished surface must be used (and on the mandrel) o Extreme forming or high yield strength: speed of rotation and feed must be reduced
Joining	o The subject of joining technology should be clarified in the development phase so that all points are taken into account later during assembly and both mechanical and decorative properties are retained o The surface requirements, the properties of the coating and, in some cases, the forming properties of the substrate must be taken into account here o Spot joining techniques can be optimally combined with adhesive bonding	Adhesive bonding	o Before bonding, the surface must be dry and free from dust and chemical residues o The soiled surfaces must first be cleaned with a clean cloth or soft brush and then with a cloth soaked in isopropanol
		Clinching	o The strength of clinching may only be slightly reduced by the use of an organic coating o Elasticity can be improved by heating
		Riveting	
		Flanging	o On the outside the print is stronger (critical area) o Polishing of the tools (punches), sufficient clearance to avoid bruising in the layer o Max. punch edge radius of the knife o Ideally, an articulated punch and cam system that allows also a rotation of the punch
		Lock seaming	o Use coatings with sufficient bending flexibility
		Joining with Bolts, Studs, Clips	o Correct choice of material decisive: plastic-coated screw heads and plastic washers
	o Topcoated sheets are only suitable for welding to a limited extent. Reason: the higher organic layer thickness of about 20 to 60 µm --> welding is only possible when metallic contact is present o A liquid paint may only be coated on one side or at most a thin back coat o The appearance of the surface is damaged because part of the coating is burned during welding	Welding (resistance projection welding, stud arc welding)	o One-sided welding processes with short welding times and low electrode forces can be used o Short-cycle projection welding including capacitor discharge or medium frequency techniques are best suited due to its very short welding time and low electrode forces o A matte structure is less sensitive than a thin high-gloss visible side
		Welding (MIG, MAG, TIG, plasma, laser, etc.)	o In the area of the joint, the coatings evaporate o The appearance of the surface is strongly negatively affected o The burn-off of the paint layers is the reason why arc welding processes are hardly ever used

PRACTICAL IMPLEMENTATION FOR CPP-SYSTEMS

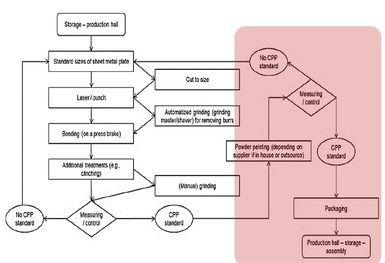
Procedure Comparison

It is not only the painting process that would be eliminated at the end before packaging or assembly, but also the control of the paint quality and all the expenses related to the painting:

Test Run in Poing

Materials

- Structural steel S280GD + Z275 (hot-dip galvanized with zinc coating 275 g/m²). The top and back coating: polyester polyamide coating. Color: black-gray, sepia-brown.
  - It is a more structured system with polyamide particles.
- Structural steel S280GD + Z275 (hot-dip galvanized with zinc coating 275 g/m²). The top and back coating: polyester polyamide coating. Color: black-gray, sepia-brown.



The sheet metal on the reverse side has been scratched by the punching machine. The visible side is scratch-free and the paint is undamaged, although no protective film was used. The white 0.8 mm sheet was formed with a 1.5 mm die as no separate program was prepared.

LOGISTICS

The infrastructure in the production hall must be adapted to ensure proper handling of the materials. The fact that employees need to be trained with the materials did not prove to be a major expense during the test run.

The delivery time for a continuous process corresponds to the customer's request. For a specific color selection, the initial integration can take between 12 weeks and up to half a year until everything is matched.
Basically, the material is available in standard colors in any order quantity. Usually, the companies' own requirements with specific functional and decorative properties are imposed on manufacturers. In this case, the minimum order quantity is always one coil. In terms of weight, quantities between 5 and 23 tons were mentioned for this purpose.

MAGIC TRIANGLE

▪ *Quality*

Precoated sheets are, all in all, high-quality materials that are excellent for processing. The sample tests were able to confirm the good forming properties from the theoretical principles. The bends caused no machine marks, and no damage was visible on the lacquer. It must also be taken into account that the tests are only test materials and do not yet have the final required properties. It was already introduced at the beginning of this report that this is a decades-long technology that is constantly being developed. The manufacturer is able to produce all colors, with constant coating quality on the entire coil due to automation.

▪ *Time*

The process time is reduced by all efforts that are directly or indirectly related to a final coating, as this is saved. The duration of the actual forming operations could take longer overall for precoated materials than for galvanized sheets without any claim to a scratch-free surface.

There is also a certain amount of time involved in training employees how to handle the materials. The process time between initial contact and the desired semi-finished product takes between three and six months.

▪ *Costs*

As an indication, the price between 1.200 and 1.600 EUR/Ton was mentioned by ECCA. In comparison, galvanized sheet costs about 0.85 EUR/kg (before crisis). That makes a difference of ~ 40 %.
Overall, productivity and yield increase, while manufacturing, energy, storage and financing costs decrease. In general, total production costs must be lower despite higher material costs but lower manufacturing.