U. S. Steel Košice

TECHNICAL GUIDE

GALVANIZED STEEL WITH THIN ORGANIC COATING

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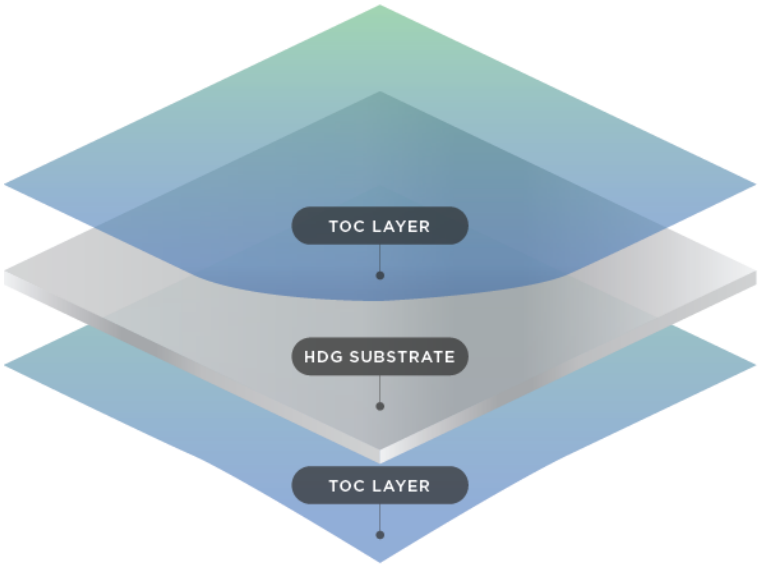
Galvanized steel with Thin Organic Coating

TOC is an excellent choice for applications, where traditional passivated or oiled galvanized materials are used. It represents a great solution for both, interior as well as exterior application. Currently, U. S. Steel Košice offers TOC as a transparent film. Thanks to its multifunctional properties TOC is an excellent choice for industrial areas, especially for appliance manufacturing. Upon the customers' request, we will be able to deliver galvanized steel with the TOC layer in various color finishes in the future.

TOC is mostly organic, containing a small inorganic component. One of the most significant benefits of TOC is improved corrosion resistance. The long term corrosion protection of the zinc surface is achieved thanks to both, the TOC layer's thickness and anti-corrosion inhibitors (Cr^{3+}, Ti) that are its components.

TOC applied on the zinc surface provides up to three times better anti-corrosion properties than the conventional passivation protection extending the lifetime of a conventional product significantly. TOC also improves the pressability of sheets (friction coefficient (f) stays below 0.15), thus enabling also full elimination of pressing oils. TOC also has anti-fingerprint characteristic (AFP – AntifingerPrint), helping to keep an optimum surface appearance



during use. This is important especially for appliances. The coating itself is applied on the zinc surface with rollers in a continuous process directly on the galvanizing line.

Also, TOC has an excellent adhesion to PUR foam. With respect to the end uses, TOC represents the final surface treatment of sheets. In case the application of subsequent layers is required, as opposed to passivation, TOC does not have to be removed from the sheet surface.

Thin Organic Coating is a thin film with typical specific weight (1.0 through 2.5 g/m^2) on Cr^{3+} and Ti basis, providing permanent multi-functional surface treatment of galvanized sheets.

COATING MICROSTRUCTURE

Take a detailed look and see the difference

Figure 1 shows the microstructure of the galvanized coating with conventional passivation compared to the new type of TOC protection. In the cross section, it is possible to see a TOC layer that reaches the thickness of a dry film of about 0.8 – 2.2 µm. The passivation layer thickness is very difficult to capture since the thickness of the dry passivation film is significantly lower.

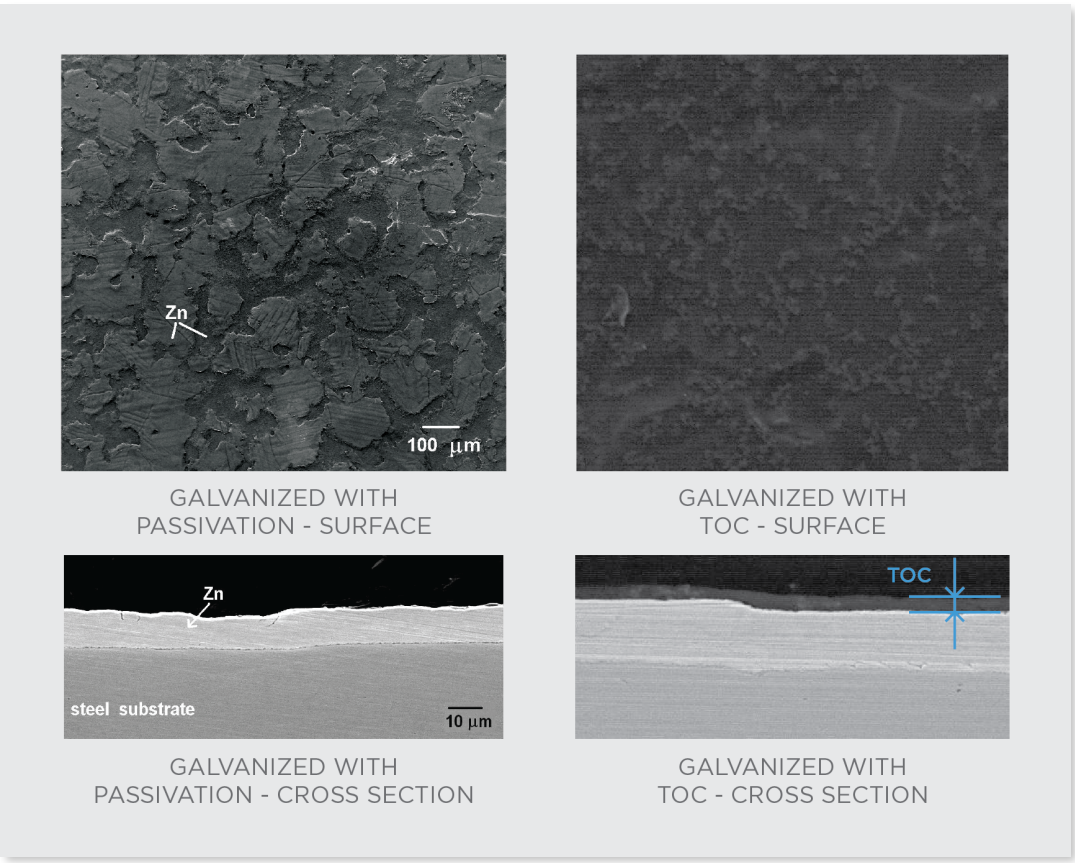


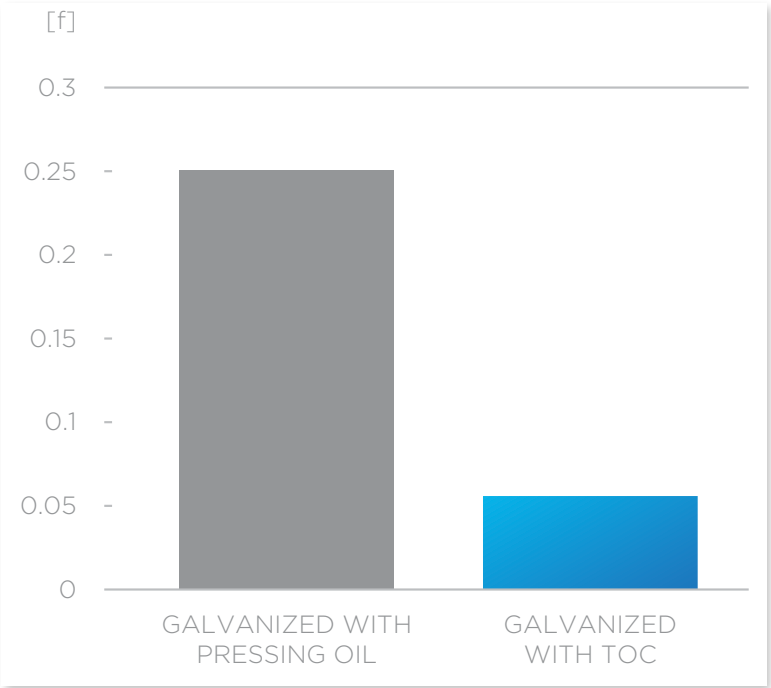
Figure 1 Structure of traditional GI coating with passivation and GI coating with TOC

PRESSING

Intelligent solution to improved pressing

Conventionally, to improve pressing properties while forming galvanized steel means using pressing oils or lubricating the material during the process. However, this traditional method is associated also with some disadvantages, such as environmental impact or contamination of the working environment. TOC represents an intelligent solution for some industries.

One of the methods of measuring the pressability is the determination of the friction coefficient "f" using the cup test. TOC can **decrease** the friction coefficient at least **three times** compared to conventional pressing oil. As shown bellow, using galvanised steel with TOC helps to decrease the friction coefficient below the limit of f < 0.1



Graph 1 Comparison of friction coefficient "f" between two different zinc surface treatments

CORROSION TESTS

Three times better corrosion resistance compared to passivated HDG

The rapid corrosion tests were performed in aggressive atmosphere of neutral salt spray according to the international standard STN EN ISO 9227. During the corrosion test the time until the white rust origination on the galvanized sheet surface, i.e. first zinc coating oxidation, was monitored. Figure 2 shows the testing equipment used for the corrosion tests.

Figure 2 Chamber used for corrosion tests

Corrosion test – conventional passivation vs. „TOC“

Figure 3 shows the kinetics of corrosion of three surface types: galvanized sheet without surface protection (GI), galvanized sheet with conventional passivation (GI + passivation) and galvanized sheet with TOC (GI + TOC). All three types of coating were exposed to corrosion environment of neutral salt spray in accordance with the standard STN EN ISO 9227.

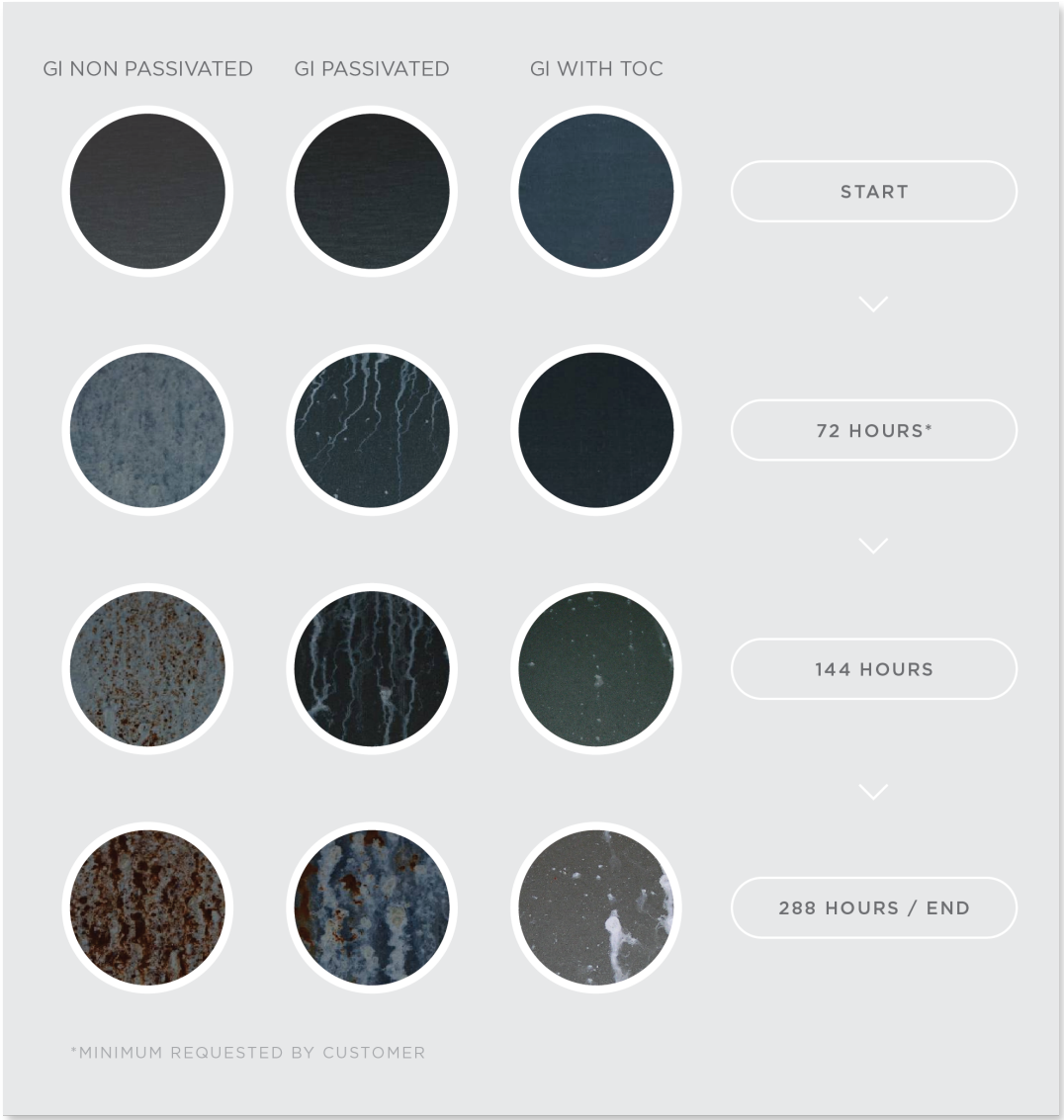
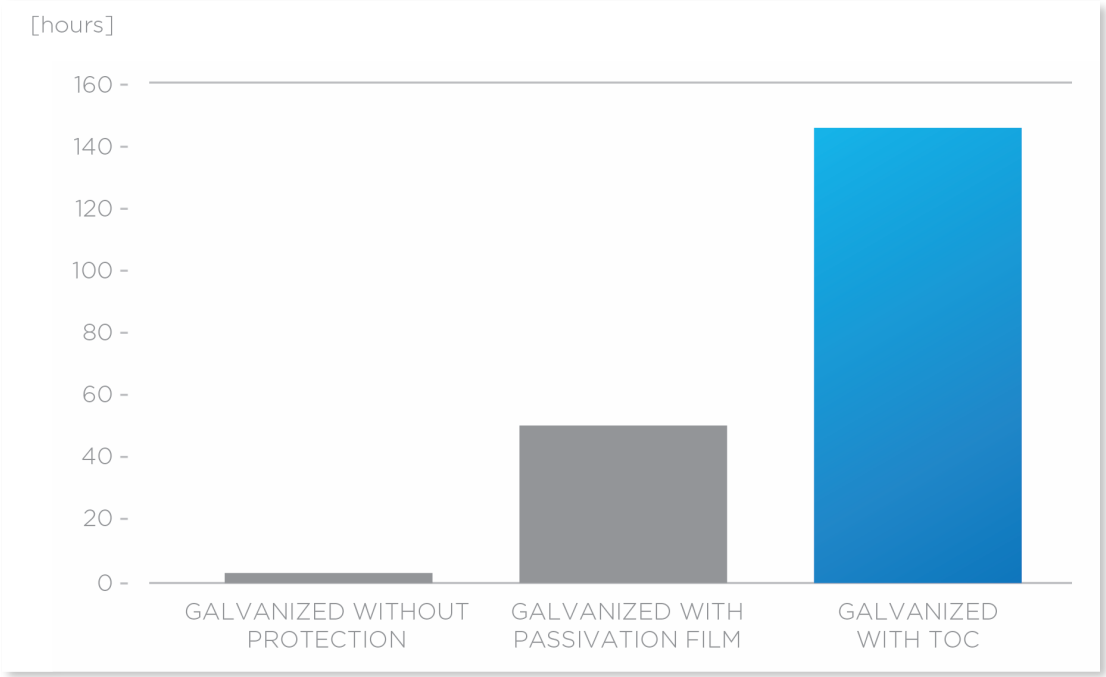


Figure 3 Corrosion on GI with galvanized with differen types of final protection

Primarily, the time until the origination of the first white rust, i.e. zinc coating oxidation (efficiency of final anti corrosion protection) was monitored. It is obvious that the zinc coating treated with the TOC shows better resistance in

the particular corrosion environment, three times better than the minimum resistance, in comparison with the conventional passivation protection (Graph 2). In addition, the conventional passivation on the galvanized steel material is used for temporary material corrosion protection, mainly during its transportation and storage and usually needs to be removed before further processing of the material. Contrary to passivation, the TOC serves as permanent surface protection that **does not need to be removed,** not even when other layers are to be applied.



Graph 2 Comparison of corrosion resistance of Gl coating with different types of protection

Corrosion test – organic coating (lacquer) vs. „TOC“

While conventionally applied organic coating is typically used within many industries, its final thickness is multiple times higher the thickness of the TOC. Also, it is typically applied separately on a color coating line at significantly higher production costs. In some areas, the conventional organic coating can also be replaced by the TOC and such a surface also obtains the above mentioned supplementary properties.

During corrosion tests of color-coated sheets the organic layer delamination from artificially created “X” shape indent reaching up to the zinc substrate is

monitored, thus simulating eventual sheet surface damage during product installation and use. Figure 4 shows for comparison purposes the kinetics of the corrosion on two surface types – GI with applied TOC and GI with paint (color coating).

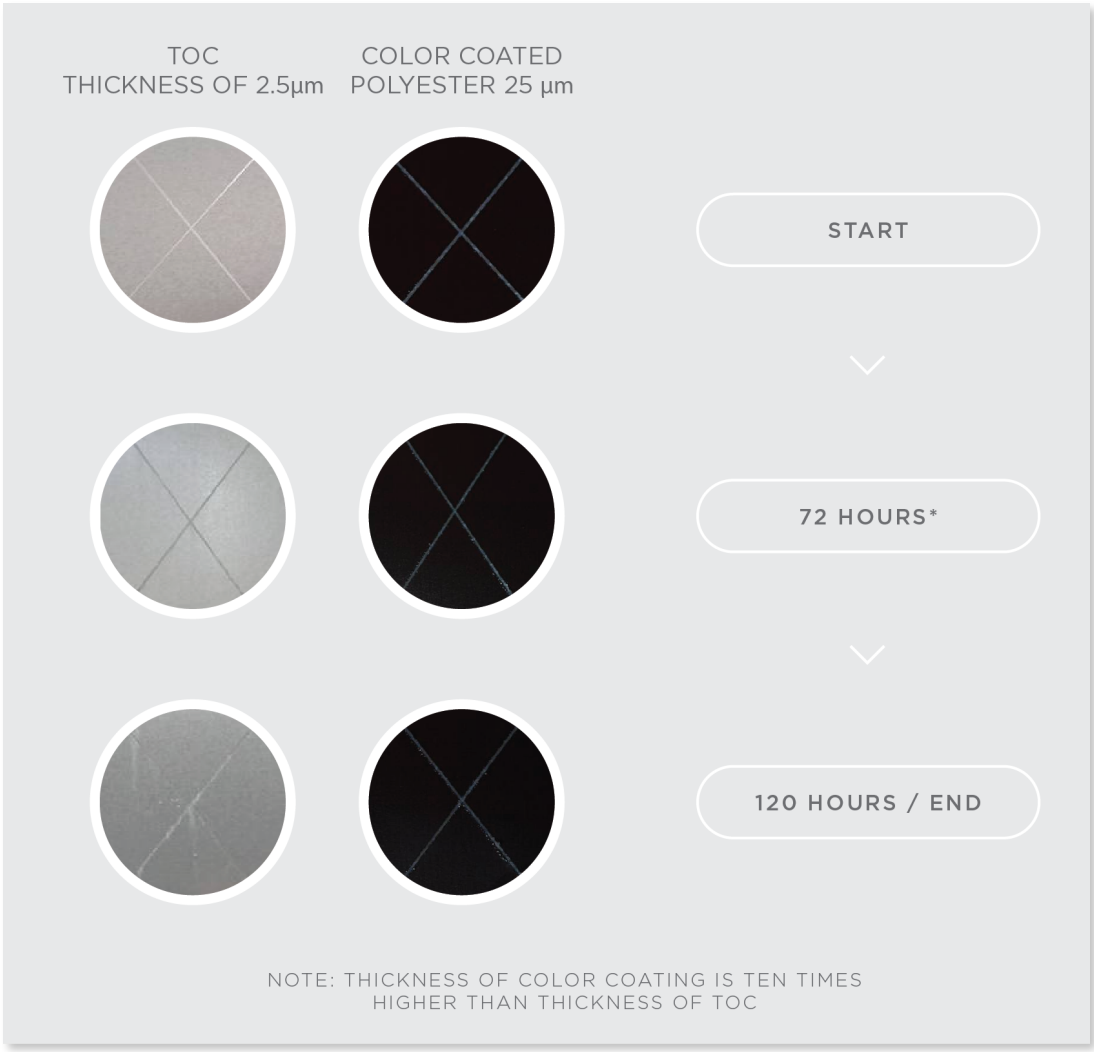


Figure 4 Comparison of GI + TOC vs. color coated

BUILDING VALUE TOGETHER

U. S. STEEL KOŠICE, S. R. O., VSTUPNÝ AREÁL U. S. STEEL, 044 54 KOŠICE, SLOVAKIA

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