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### A Discussion on Guardrail Coating Types and Thicknesses

AASHTO M-180-00, the governing specification for highway guardrail items, does allow for coating thickness of either 1.8 oz. (Type I) or 3.6 oz. (Type II). Furthermore, cold-rolled guardrail can be galvanized before fabrication in a “continuous” method (Pre-Galvanization) or after fabrication in a “batch” method (Hot-Dipped). The only distinction between the two styles of application, as noted in M-180, is that “Uncoated edges resulting from transverse shearing or punching of holes will not be considered objectionable.” (Sect. 9.1.3) Hot-dip galvanized materials do not have any exposed edges, whereas guardrail formed after galvanization will have exposed edges on the longitudinal ends and at any hole locations.

Regarding the material costs, and all things being equal, the additional zinc coverage obtained in Type II coatings adds about \$0.05 per linear foot. The lowered cost of Type I is due to the reduced zinc, which lowers both materials cost and freight per unit over truckload quantities. However, the availability of Type I coatings is limited due to the application process used in Pre-Galvanized items, that allows for a much lighter coating to be applied. Hot-Dipped guardrail items rely on a time-temperature equation that can obtain a thickness very near Type I. However, manufacturing tolerances limit the effectiveness of applying such a thin coating using batch galvanizing methods.

The storage factors, of both Type I and II are similar enough to not warrant additional expense. However, experience has shown that Type I coatings, especially those applied prior to fabrication, have a higher tendency towards the formation of “white-rust” when stored improperly. White rust, in itself, is not be considered objectionable, nevertheless, it can indicate potentially inferior galvanization, and if left untreated, can result in advanced corrosion. Fortunately, if stored to American Galvanizers Association recommendations, both coating thicknesses and application methods will provide a consistent product with the maximum designed service life.

Installation costs of both Type I and II guardrail are identical, though there have been claims that pre-galvanized guardrails are easier to handle and faster to install than Type II. Type II, hot-dipped galvanized guardrail over a 12’ 6” W-Beam span is roughly 3 ½lbs. heavier (~3%) than Type I. Additionally, hot-dipped coatings have a traditional silver spackled appearance, while pre-galvanized coatings are typically a smooth, dull grey. This can create an interesting aesthetic when placed next to hot-dipped items in the

field, which is especially apparent at bridge ends and terminal systems, where many components are only available, or specified to be, Type II.

Unfortunately, the different visual appearance of Type I has also lead to the assertion that the guardrail is safer to handle as it is free from any sharp “icicles” or splinters. Nonetheless, the coatings of hot-dipped guardrail items are no more difficult to handle, as the requirements listed in M-180 Sect. 9.1.4 clearly state that “The coating shall be smooth and free of beading or sharp projections along the edges...” This specification ensures that both Type I and II coated guardrails, regardless of application, will be equivalent in their composition, finish, and structure.

However, the most direct comparison between the two coating thicknesses, lies not within their initial costs or appearances, but rather with those factors associated with the expected service life of the guardrail. In many cases, budgets do not allow or provide for adequate maintenance of guardrail barrier systems. Thus, it is of utmost importance for a designer or a highway agency to consider the service life and maintenance costs of a safety product prior to including it in inventory. In all cases, the coating thickness is directly related to the expected service life of the item.

There have been claims made that Type I coating applied via pre-galvanization will provide a service life “to first rust” longer than that of Type II hot-dipped guardrail. This statement is true in that it distorts the obvious. Any galvanized metal product will in time “rust”, however the capacity of the remaining zinc to oxidize before the steel underneath is not diminished. Furthermore, service life is not based upon “first-rust”, but to “serviceable-rust” which is critical distinction. “Rusted” guardrail can, and will, continue to perform as designed, as long as the base metal is non-corroded. It is only when significant mass is lost, or holes and cracks appear, that a guardrail beam needs to be replaced.

Type II coatings, on average, will show first rust at 10 years, and need serviceable replacement at 25-30 years. Type I coatings will show first rust 10-15 years, but will require replacement in 20 years. The relatively slower rate of surface rust formation in pre-galvanized products is due to the creation of a modified zinc alloy at the steel surface that has enhanced oxidation capacity. However, the coating thickness itself still remains a greater factor in the long-term safety of the guardrail product over its serviceable life.

The recent change in the specifications of a number of states to using requiring Type II coatings, was caused by premature rusting and replacement of Type I guardrail at ~12 years. Many other states we do business in have either expressed concerns at the use of Type I coatings and are considering action, or have not found it to be used within their state, even though old specifications allow. This latter scenario is more than likely due to the limited source and availability of Type I guardrail.

In summary, guardrail products galvanized through either continuous or batch methods should be considered consistent and equivalent products per AASHTO M-180.

However, the noted differences between the two allowed coating thicknesses create doubt in the long-term performance and cost-savings of Type I material.