## C22 Comparison of Slip Resistance of Tread Plate and Smooth Steel With Various Finishes Using a Variable Incidence Tribometer (VIT)

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After attending this presentation, attendees will understand: how the slip resistance of tread plate (aka diamond plate) steel compares to flat plate steel, and how paint coatings can dramatically affect the slip resistance of both tread plate and flat steel products.

This presentation will impact forensic science community by showing that physical design differences of walking surfaces, as well as coatings on those surfaces can dramatically affect the slip resistance of the surface.

This study was the result of a slip and fall accident that took place on a hydraulic lift gate installed on a truck that was used for transporting used tires. The lift gate had been manufactured approximately five months before the incident. Although optional surfaces were available, the lift gate was originally manufactured with a flat plate-steel surface coated with a primer. It was subsequently painted with an acrylic enamel paint and then installed onto the truck. The truck was driven to various automobile tire shops where worn out tires were picked up to be recycled. Many of the tires had varying amounts of rainwater within the carcass, which would splash out when being thrown onto the truck. There were also intermittent rain showers the day of the incident.

At the time of the slip and fall, the lift gate was elevated to the same level as the bed of the truck, several feet high. A man wearing work boots was standing on the surface of the lift gate and was observed by witnesses with his feet above his head and his back parallel to the lift gate surface. As his body fell onto the surface, the back of his head hit the edge of the lift gate resulting in serious injuries. The surface of the lift gate was reportedly wet at the time of the fall.

It was hypothesized that the painted finish of the lift gate contributed significantly to the likelihood of a slip on the lift gate, and that several of the various lift gate options available were more slip resistant and thus safer under foreseeable and expected conditions of use. Since the accident had taken place three years prior to the engineer's involvement, the original surface material and condition were no longer available for testing.

**Test Method:** Samples of tread plate and flat plate-steel were obtained and prepared for slip resistance testing. A sample of each material was left uncoated; coated with the same primer used on the lift gate; and coated with black acrylic enamel, the same enamel the lift gate was coated with. Each of the surfaces were tested dry and wet using an English XL tribometer (aka Variable Incidence Tribometer (VIT) or a Variable Angle Tribometer (VAT)) to determine the slip resistance properties of the various uncoated and coated materials. Testing was performed in accordance with ASTM Standard F-1679 and the VIT manufacturer's operating instructions and use manual. Each sample was tested at least four times and the tests results were averaged.

**Results:**

| Material description | Avg. Slip resistance (Dry/Wet) | |
|---|---|---|
| Smooth Bare Steel | .93 | .42 |
| Primed Smooth Steel | .79 | .48 |
| Painted Smooth Steel | .89 | .26 |
| Bare Tread Plate | .78 | .68 |
| Primed Tread Plate | .76 | .72 |
| Painted Tread Plate | .76 | .60 |

**Discussion:** There are at least two consensus standards that put forth guidelines for slip resistance levels on walking/working surfaces. ANSI A1264.2 - Provision of Slip Resistance on Walking/Working Surfaces has published the guideline value of 0.50 as a reasonable level of slip resistance for walking/working surfaces. NFPA 1901 – Standard for Automotive Fire Apparatus sets a minimum level of slip resistance under wet conditions for exterior surfaces as measured with the VIT, as 0.68.

Results of the slip resistance testing showed that the smooth steel surface was marginal to unacceptable (depending on the above test method criteria used), in the bare (.42) and primed (.48) condition under wet conditions but otherwise acceptable dry (.93 and .79 respectively). The acrylic enamel painted smooth steel surface was acceptable dry (.89) but significantly more slippery when wet (.26). All of the diamond plate samples, except the painted (.60), were found to have acceptable slip resistance properties in both the wet and dry condition.

**Conclusion:** The evaluation of the various surfaces using the VIT tribometer illustrates the utility of this particular tribometer as a tool in assessing the safety of a walking/working surface. The hypothesis that the painted smooth steel surface contributed to cause the slip in this case, and that other options were safer, was

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supported through test evaluation of the available surfaces under foreseeable conditions.

**Slip Resistance, Slip and Fall, Tribometer**

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