COMMENTS TO THE DEPARTMENT OF LABOR

Occupational Safety and Health Administration
29 CFR Part 1926

RIN 1218-AC14
[Docket No. S-775 A]
Steel Erection; Slip Resistance of Skeletal Structural Steel
ACTION: Notice of proposed rulemaking; limited reopening of rulemaking record.

Submitted by:

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Background

Before I provide comments on the above docket, I felt that I should state my unique involvement on several levels with slip-resistance and structural steel.

Currently, I am the president of a small consulting company employing several individuals which I established in 1997. My most recent interest has been in the area of slip-resistance measurement. I recently completed an MS in Safety Sciences with a thesis on the effect of stiction on slip-resistance measurements using drag-sled devices. I am a member of ASTM committee F-13 and I am certified as an XL tribometrist. I have been testing flooring and coating surfaces for manufacturers over the past several years.

I am also involved in other family businesses from an ownership perspective. One of the larger business units is High Steel Structures, Inc., the largest structural steel bridge fabricator in the United States. Our facilities produce some of the highest quality structural steel bridges and in some cases erect them in the field. Prior to starting the consulting practice, I was the corporate safety director for our companies which included the steel fabrication group. You might also be aware that this facility is a VPP OSHA STAR facility and we hold safety in high regard within our organization.

Our family also has a general construction company which is involved in the erection of building steel in as much as we oversee the work of our sub-contractors performing these activities.

From this perspective, I have the opportunity to consider the requirements of the OSHA standard on many from fronts and offer my comments.

Support of Slip-Resistance as a Criterion for Coating Performance:

While slip-resistance does not provide a positive means of protection from falls, it becomes important for the steel erection industry for several reasons:

(1) The negotiated OSHA standard permits employees to be exposed to falls up to 15 feet and in some cases up to 30 feet. These fall distances are significant and are likely to result in serious injury or death. Since many employers opt to follow this minimum standard, slip-resistance of walking surfaces is a final opportunity for OSHA to reduce some of this fall risk.

(2) In some cases (initial connections of primary bridge members) traditional fall protection options are simply infeasible and impossible. In these cases, slip-resistance is extremely important.

(3) The multi-part coating systems used on many bridge structures tend to be very slippery, especially when wet and as a result ironworkers are exposed to a significant hazard.

Response to Questions Regarding Testing Methodology:

> *Whether the test methods identified in § 1926.754(c)(3) and Appendix B to Subpart R -- or any other test methods that are available, or reasonably can be expected to be available by July 18, 2006 -- are suitable and appropriate to evaluate the slip resistance of wetted coated skeletal structural steel surfaces on which workers may be expected to walk in connection with steel erection activities.*

The testing methods ASTM F1679 and F1677 are the most effective methods to assess slip-resistance based on today's current science. There are **NO** other recognized testing methods which have the same level of performance as these tribometers for wet surfaces.

Traditional drag-sled methodologies are subject to stiction (also spelled sticktion) effects as a result of residence time. It is not my intent to go into a detailed discussion on stiction effects as there is plenty of scientific literature which discusses these effects. It is important to note however that stiction will cause drag-sled technology testing devices to overstate slip-resistance in a wet condition. In fact I have seen manufacturers represent their products as having a higher slip-resistance wet than dry! While this can occur, my immediate assumption is that someone used a drag-sled to assess slip-resistance in a wet condition. This miss-information can be dangerous for the users of these products.

Since slips most often occur as a result of liquid contamination, the assessment of slip-resistance in a wet state is of the utmost importance.

Methods which utilize a walker are highly variable and expensive to perform in a manner which would provide high reliability. Individual gait characteristics (to a limited extent), muscle strength, specific test-conditions and the ethical aspects of using human subjects in testing are all factors which make these types of tests impractical for routine testing of coatings or surfaces. Obviously, field testing is not even a possibility with these methods.

Comparability between the Specified Testing Methods:

While there is some variation in the results between ASTM 1679 and ASTM 1677, the results generally track similarly. Attached as an Appendix you will find a document which might help clarify the variation between these two test methods. I extracted, from the English-Marletta study, the results of these two methods and performed correlational analyses on wet and dry readings.

In all cases these correlational analyses provided a high positive correlation between the test methods. So, while individual readings may differ to some extent there does seem to be some connection between the results of these two test methods. This was also recognized in published testing performed by Wen-Ruey Chang of Liberty Mutual Research Institute (Applied Ergonomics, 2001).

The test foot design likely accounts for some of the variation between the English XL and Mark II testing methods. These are the only two ASTM test methods which apply horizontal and vertical forces to the surface in a simultaneous strike more effectively simulating human walking.

Because of individual variation in the results between these two devices manufacturers could opt to have their products re-tested under another method if the selected method demonstrated the product to fall below the 0.50 requirement.

Another approach would be to allow for some variation from the 0.50 standard. This value does provide some level of safety over the point at which a slip is likely to occur.

Test Foot Concerns

Some have argued that the foot of the slip-resistance tester should be textured to simulate the texture of the footwear worn by ironworkers. While textured footwear is available and should be used by workers of companies exposed to slips, this is low on the hierarchy of protection, attempting to provide PPE as a control measure, rather than controlling the hazard itself. Further, I can assure you that ironworkers' shoes wear and the wear of these shoe surfaces is often severe and includes entrapped dirt. Perhaps a good demonstration of the condition of footwear is represented in the English-Marletta May 20, 1995 report showing the footwear of the participating ironworkers.

Controlling the condition of a shoe tread in the field is not a practical solution and therefore testing using a grooved surface could over-state the actual slip-resistance. In addition, the actual contact area in a heel strike often does not involve a significant area on the shoe. The likelihood that the heel-strike will occur on the featured area of the shoe is questionable at best.

There has also been some discussion regarding the material used for the test foot. Most testing methods specify Neolite® which is manufactured to a specified standard. The material is homogenous, and its properties don't change significantly overtime as a result of water absorption, unlike leather.

Experience with English XL

Having performed many slip-resistance tests for flooring and coatings manufacturers, I can relay that my experience with the ASTM 1679 (English XL) tribometer has demonstrated the instrument to be reliable and consistent in performance and testing results. These devices provide a reasonable measure of hazard and have been relied on by most of those individuals involved in tribometry.

The manufacturer of this device in conjunction with the International Safety Academy have developed the user training and testing program referred to as the Certified XL Tribometrist (CXLT). This program requires the user to pass a written test and perform several tests on sample materials. The most helpful aspect of this program is the opportunity to fine-tune the technique and to assure that the results the user is obtaining with their instrument is in-line with the results of others performing the test on the same test surfaces.

This program was helpful and should be continued as a requirement under OSHA's criteria for testing.

Concern over Specified Test Methods as Proprietary

ASTM recently expressed concern to the F-13 committee over the publication of standards which involve proprietary equipment. This will require the committee to likely to either re-structure the standard so that it is not device-specific or to justify to ASTM the need for the proprietary-device standards in order to offer the most up-to-date method for slip-resistance testing.

While this might seem significant, it is really a matter of internal adjustments to the standard to meet ASTM's requirements. No doubt the test methods for the English XL and Mark II will be included in any revision or re-definition of the ASTM standard. For this reason it may be appropriate for OSHA to consider wording which would provide for changes in the testing standards without requiring a standard change nor require manufacturers to re-test products every time an updated standard is released.

As these are patented testing devices, it is a concern of mine that the producers are relatively small sole-proprietor which in the event of death could result in the production and servicing of these devices to be interrupted. It would be to the benefit of OSHA, the producer and the users to assure that a succession plan for the continuation of the production and patent rights is defined. The patent on the Mark II expires in January of 2009 and the English XL in November of 2013 assuming a 20 year patent window. While this is a recognized risk of this rulemaking, it is a greater risk to allow fall exposures to ironworkers.

Other testing methods could be developed with utilize a similar approach to avoid residence time. These devices might be also appropriate to use to assess slip-resistance in the future. The use of ASTM methods helps to assure that testing methods have had gone through a consensus process of the involved participants.

At the same time OSHA should be cautious in using phases such as “or equivalent methods” as this opens the door for testing methods which may not effectively evaluate slip-exposure.

Whether skeletal structural steel coatings that comply with the slip resistance criterion of the Standard when tested under the identified method(s) are commercially available -- or reasonably can be expected to be commercially available -- by July 18, 2006, and whether the use of such coatings will be economically feasible.

While the coatings industry is in the best position to comment on this aspect, I will provide some observations regarding the availability of coating systems.

Precision and Bias (P&B)

While a precision and bias statement has not been included within the ASTM standards specified, much of the work behind establishing this statement is complete. In January of 2000, the F13 committee conducted a workshop on the English XL in which round robin testing was repeated similarly to the testing performed in 1998. While this testing demonstrated a precision level which exceed that of other testing methods (i.e. ,C-1028 test method). The inclusion of this into an updated standard is expected in the future. The P&B statement has been a point of contention for some individuals and organizations which 1) either don’t like the answers they get testing wet with a method that avoids sticktion or 2) have the potential to lose work or sales as a result of drag-sled methodologies being identified as a deficient testing methods.

Coating Availability

Not all coating systems are the same. Most of the coatings used in the 1995 English-Marletta study performed at levels which were above the established level of 0.50 when tested wet. Therefore in 1995 there were coatings available which already complied with this requirement, albeit several of these were experimental at the time.

I have recently completed a series of tests for a paint manufacturer whose products are used on steel structures. One of the seven coatings which I tested passed with a wet slip-index above 0.50. Some of these coatings were extremely slippery when wet. Due to client confidentiality this is the extent of the information which I can ethically share. So it appears that many coatings may need to be re-formulated.

It is my experience that many organizations wait until OSHA standards have been finalized for some period of time before they actually consider implementing the standards requirements. This is perhaps a function of procrastination but also likely as a result of companies seeing past regulations withdrawn. (i.e., 29 CFR 1910.900 – Ergonomics).

I am just now receiving calls from coating companies which desire to have their coatings tested based on the Subpart R requirements. If they are just now looking at these issues, they may be under pressure to create compliant coatings. However, I would suggest that additional implementation delays would most likely result in more procrastination. I am sure that this is not the case with every producer and my exposure to the paint industry is limited.

Coating manufacturers will need to change existing products which do not meet the OSHA specification. Some coatings may already meet these requirements. Re-formulated coatings will need to be tested for performance characteristics beyond slip-resistance.

In order to assess the performance of existing coatings used in structural bridge steel, I conducted an informal testing of pieces which were completed and ready for shipment to jobsites.

A summary of these tests is presented on the following page. Identification of the paint type and manufacturer was specifically omitted. These tests demonstrate that two of the three selected coatings could meet the slip-resistance testing requirement.

Slip-Resistance Performance of Steel Bridge Coatings on Pieces ready for Shipment to Job Site: July 29, 2004

Testing was performed by Steve High of High Safety Consulting Services at High Steel Structures, Inc., the nation's largest steel bridge fabricator located in Lancaster, PA. All pieces were located in the storage yard of the bridge fabricator awaiting shipment. The test areas were wiped down with distilled water prior to testing to remove surface dirt and debris.

Wet testing was performed under ASTM F1679. Dry testing was not performed. A formal standard report was not prepared as this project was performed without compensation or funding. The intent of this testing was to provide a response to OSHA's request for comments on the slip-resistance aspects of painted steel in the Steel Erection standard (Subpart R) under 29 CFR 1926. The pieces which were tested were not positioned exactly on level as re-positioning and leveling of very large structures was not practical for this testing. Any variation in the effects of out-of-level testing should be equalized by the averaging of the testing results in all directions and the VIT is not gravity dependant for operation.

Job Number	Coating Used	Results NORTH	SOUTH	EAST	WEST	AVG.
PA 02026-1 F636M N Column Piece	White – 2 coat system Carboline 888 Epoxy	0.66	0.61	0.68	0.56	**0.63**
2-92120 D9-C Diaphragm Member	Brown Not Determined	0.29	0.24	0.29	0.26	**0.27**
SC-01188-02 G# GIB-CSK Straight Girder	White – 3 coat system Carbothane 133HB	0.73	0.72	0.73	0.75	**0.73**

Conclusions: **Two of the three surfaces tested performed well and would meet OSHA's requirement for slip-resistance performance indicating that coatings with adequate slip-resistance are in fact available and in use**! The third surface, a high gloss epoxy, was dangerously slippery when wet.

Application Methods

Application of new coatings may be of concern. The 1995 study (English-Marletta) identified that the spray equipment used to apply standard coatings became clogged as a result of the reformulations. As a result, these coatings were applied by brush. Application methods and coating performance is a science. In steel bridge coating applications the coating systems must be applied to strict tolerances. The spray apparatus is designed to be used with specific paint types. Therefore an alteration in coating equipment is a possible impact to the structural steel bridge industry.

I might also note that as a result of delays in passing a new transportation bill and the impact of steel price changes, the steel industry is not in a position to bear additional costs in the short-term future. While this is not a reason to delay the requirement, as the above data demonstrates that coatings do exist which can be applied with existing equipment which will meet the OSHA requirement.

Specification Requirements with State DOT's

One **major** concern and perhaps the most important regarding implementation of OSHA's mandate is that state DOT's provide the specifications for steel bridge structures. These specifications include paint requirements. Since there is a lag between the jobs which are put out of bid and the actual production of the super-structure, jobs which are being bid now may be produced in 2006. Therefore, these specifications on paints will place employers / paint manufacturers into non-compliance.

In addition, unless State DOT's specify the proper coatings for these structures the OSHA rule will have no effect. That is, manufacturers are mandated by contract and state DOT to use the specified coatings. This situation could be compared to the long process of having state DOT's stop specification of lead-containing coatings. Even as late as the mid-eighties, our company was applying lead coatings as a result of state specifications which mandated their use despite the wide recognition that less hazardous options were available.

OSHA should open dialogue with the state DOT's to assure that they are aware of these requirements and that they include them in their bid specifications. OSHA should consider applying the requirement to only those projects bid after the effective date of slip-resistance requirement and after coordination with the state DOT's to assure that these requirements are included in bid documents.

Environmental Factors

In the limited testing I conducted on bridge girder coatings, I also observed that many of these pieces had collected a fine coating of dust from storage in the facility yard. This dust as well as other contaminants could have an impact on slip-resistance. Therefore, assuming that the slip-resistance available to the ironworker will be 0.50 may not be valid. This is not to suggest that the criterion for slip-resistance should be sidelined, but rather to recognize that a margin of safety is needed and the 0.50 value which has been established does in fact provide some margin of safety. It is a common practice in safety and engineering practices to provide a margin of safety which helps to account of unknown or less than ideal conditions under which a system was designed.

Expansion of the Slip-Resistance Requirements

While it is beyond the scope of this specific request for comments, I would like to express a specific concern regarding the lack of a slip-resistance performance requirement for deck plate. Deck plate, used in most building construction, has much more foot traffic, often by individuals with less experience in working at heights.

This material is often contaminated with oils from the manufacturing process and is extremely slick when wet. The installation of deck is hazardous and yet like the erection of primary steel support structures OSHA permits this activity to occur without fall protection (in a controlled decking zone) up to 30 feet (or 2 stories whichever is less). The rationale of requiring slip-resistance for the primary support members and not requiring it for exposures of the same height on deck plate is inconsistent. While I understand the negotiated rule-making process is one of give and take, I believe that exposure to deck plate as a walking surface is also one that OSHA should re-consider (29 CFR 1926. 754(c) (2)).

Treatments of the plates or even the manufacturing of the plate could be altered to provide for a slip-resistant surface.

APPENDIX A

CORRELATIONAL ANALYSES OF DATA VALUES REPORTED IN PREVIOUSLY PUBLISHED STUDIES USING THE ENGLISH XL AND MARK II TRIBOMETERS.

Presented by:
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Study Title: Investigation of Surface Slip Resistance on Structural Steel

Authors: **William English, CSP, PE**
Dr. William Marletta

Date of Study: May 20, 1995

Sponsor: The Center to Protect Workers' Rights

Data Used: The average of the reported test results for seven different surfaces tested with the Mark II and English XL.

DRY TESTING RESULTS

The following results demonstrate a *very high positive* (R=0.914) correlation between the MARK II and the ENGLISH XL testing methods using the average data values as reported.

Data Values:	Mark II	English XL
Dry Tests	0.82	0.95
	0.85	0.89
	0.87	0.90
	0.63	0.69
	0.68	0.74
	0.76	0.78
	0.73	0.83

R = 0.914 Y = 0.97 + 0.08

WET TESTING RESULTS:

The following results demonstrate an *even higher positive correlation* for wet testing results (R=0.929) between the MARK II and ENGLISH XL test methods.

Data Values:	Mark II	English XL
	0.74	0.83
	0.59	0.75
	0.72	0.90
	0.55	0.62
	0.14	0.14
	0.51	0.34
	0.25	0.32

R=0.9286 Y= 1.19X – 0.04

[END]