Evaluation of Tyregrip® High-Friction Surfacing

WA-RD 788.1

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June 2012

Washington State Department of Transportation
Office of Research & Library Services

WSDOT Research Report

Post-Construction Report
Experimental Feature 10-02

Evaluation of Tyregrip® High-Friction Surfacing

SR-14
SE 164th Ave Interchange
MP 7.93
014 S2 00794 Ramp
SE 164th Ave Southbound to SR 14 Westbound




Washington State Department of Transportation

Engineering and Regional Operations
Construction Division
State Materials Laboratory

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
WA-RD 788.1		

4. TITLE AND SUBTITLE	5. REPORT DATE
Evaluation of Tyregrip® High-Friction Surfacing	June 2012
	6. PERFORMING ORGANIZATION CODE WA 10-02
7. AUTHOR(S) Keith W. Anderson, Mark Russell, Justin Sheets, David Burkey, Jeff S. Uhlmeyer, and Jim Weston	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Washington State Department of Transportation Materials Laboratory, MS-47365 Olympia, WA 98504-7365	10. WORK UNIT NO. 11. CONTRACT OR GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Washington State Department of Transportation Transportation Building, MS 47372 Olympia, Washington 98504-7372 Project Manager: Kim Willoughby, 360-705-7978	13. TYPE OF REPORT AND PERIOD COVERED Post-Construction Report 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

This study was conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

16. ABSTRACT

This report describes the installation of Tyregrip®, a high friction surface, on a high accident location to reduce accident rates. Tyregrip® is a thin polymer overlay system that uses a two part epoxy binder and calcined bauxite aggregate. Post-construction friction resistance results in the middle to high 70's indicate that the Tyregrip® has improved the friction properties of the collision prone ramp.

The installation will be monitored for friction resistance and accident reduction for a minimum of five years.

17. KEY WORDS	18. DISTRIBUTION STATEMENT
Tyregrip®, high friction surface, high accident location, epoxy binder, calcined bauxite	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22616

19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
None	None	39	

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Washington State Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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Introduction

The ramp carrying southbound traffic from SE 164th Avenue to westbound SR 14 has recorded 27 collisions in three years. Traffic on SE 164th Avenue travels down hill before entering the sharp horizontal curve of the ramp that merging onto SR 14. Warning signs were installed to alert motorists to the hazard, but there continued to be a high occurrence of accidents. The majority of the accidents involved a single vehicle and 20 of the 27 occurred during wet weather. Increasing the frictional properties of the pavement was proposed as a possible solution to the problem given the ramp geometry and single vehicle wet condition accidents that are occurring.

There are several ways to increase friction on an HMA pavement. These include replacing the pavement, placing a surface treatment such as a chip seal or grooving the pavement by diamond grinding. The chip seal is not a good option for this location due to the potential for the loss of aggregate from the sharp turning motions of vehicles on the ramp. All of these methods are costly and the existing HMA pavement is only 15 years old and not due for rehabilitation until 2027. A less costly solution would be to install a thin, high-friction surface over the existing pavement.

Tyregrip® is one of a number of high-friction surface (HFS) systems that many state DOT's have used with some success. Tyregrip® is a resurfacing system that consists of a two part epoxy resin top dressed with calcined bauxite aggregate. Calcined bauxite is produced by heating bauxite to 1000 to 1200ºC to drive off moisture thereby increasing the alumina content. The aggregate produced is durable and provides a high friction surface.

This is the first use of Tyregrip® by WSDOT and this experimental feature will document the construction and performance of this system for a minimum of five years.

Literature Review

A number of states including WSDOT used thin polymer overlay systems as waterproof membranes on bridge decks in the 1980's and 1990's. The overlays consisted of epoxy resin or methyl methacrylate binders top dressed with small sized aggregates. The aggregates were generally selected for their durability and not necessarily for their frictional properties although

the overlays tended to have good friction resistance. The purpose of the overlays was to prevent the intrusion of deicing salts into the deck which corrode the embedded steel reinforcement.

WSDOT placed 61 thin polymer bridge deck overlays in the late 1980's and early 1990's (Wilson et.al., 1995). Sixty percent of the applications used methyl methacrylate (MMA) binders and the remainder epoxy resin binders. Performance was evaluated on 23 (13 MMA's and 10 epoxy resin) of the overlays with friction tests using an ASTM E-274 tester with a ribbed tire. The friction test results spanned a monitoring period of 2 to 8 years with the average being 5.6 years. Initial friction numbers right after application averaged 48 for the MMA systems and 59 for the epoxy resin systems. Friction numbers at the end of the various evaluation periods averaged 40 for the MMA's and 31 for the epoxy systems. The average friction number for six of the ten epoxy overlays were in the 16 to 22 range with individual tests as low as 13 (ice has a friction number of 10). The low friction results were due to the loss of aggregate from the epoxy binder. As a result, WSDOT changed the specifications to use a higher rate of 1/2 inch aggregate (two types of aggregate were used, 5/8 inch to 1/2 inch and No. 6 to No. 10). The report indicates construction problems were significant on a number of bridges. Debonding and spalling were also documented on completed overlays. Wear was not measured; however, the report states that most of the overlays would need to be redone every five to ten years, indicating wear was an issue.

The Virginia Department of Transportation (VDOT) reported on the field performance of a number of HFS applications among them SafeLane® (Izeppi et.al, 2010). The SafeLane® system uses an epoxy binder and limestone aggregate. The study concluded, based on initial friction data, that the SafeLane® overlay can provide a skid-resistant wearing and protective system for bridge decks. However, the authors pointed out that the aggregates used in the SafeLane overlays in the study are no longer being used in SafeLane® overlays (A. Hensley, Cargill Incorporated, personal communication, August 2008). Therefore, future performance may vary because of the properties of the aggregates used in the overlay. No data was provided on the long-term durability of the SafeLane® overlay system.

The Oregon Department of Transportation (ODOT) evaluated eight epoxy overlay systems on sixteen bridge decks with each system applied to two decks (Soltesz, 2010). All of

the systems were applied in the summer of 2007. The final results in 2010 showed that five of the overlays had worn through in small areas to the underlying bridge deck after as little as 1.3 million vehicles. One of the applications that wore through was Tyregrip®; however, it did maintain good friction values throughout the study.

The Florida Department of Transportation studied the effectiveness of Tyregrip® at reducing accidents on a ramp to I-75 (Savolainen et.al, 2008). Tyregrip® increased the friction number from 35 prior to installation to 104 after installation as measured with an ASTM E-274 locked wheel friction tester using a ribbed tire. Insufficient accident data prevented the authors from making a significant conclusion regarding the efficiency of the overlay in reducing accidents. What was noted was that speeds decreased and drivers made fewer excursions onto the shoulders during wet weather conditions. It was theorized that the change in speed may be caused by drivers reacting to the different surface texture of the Tyregrip®. The reduction in wet weather encroachments was attributed to drivers being able to maintain lane position due to the higher friction provided by the Tyregrip®. No information was provided on the long-term durability of the Tyregrip®.

In 1999 the Wisconsin Department of Transportation installed Italgrip® at five locations. Four of the installations were on bridge decks that had high accident histories due to wet/icy roadway surface conditions and one was placed on a segment of highway that had a history of accidents due to the formation of black ice (Bischoff, 2008). Two additional installations were constructed on bridge decks in 2002. The Italgrip® system uses a two part epoxy binder and steel slag aggregate. After five years, the friction numbers at the original five sites were 38 percent higher than the pre-installation friction numbers. There were 93 percent fewer accidents in the three years following the installation as compared to the three years prior to installation. After five or six years the surface loss varied between six percent and 37 percent. Installation cost of the Italgrip® was $13 per square yard but prices at the time of the report (2008) were in the $16 to $20 per square yard range. The report recommended that Italgrip® be considered for use in Wisconsin on short sections of roadway with high accident rates where low friction may be a problem.

In summary, there is not a lot of information on the performance of Tyregrip® or other HFS applications on surfaces other than bridge decks. Florida Department of Transportation reported excellent friction results on a freeway ramp site, but no data on the durability of the Tyregrip® was available. As noted in several of the studies, loss of aggregate and associated low friction resistance was an issue for most of the HFS systems including Tyregrip®.

Project Objectives

The three objectives of the study are:

- To measure the long-term performance of the Tyregrip® overlay with respect to friction resistance, wear and aggregate retention.
- To measure any reduction in collisions.
- To develop a recommendation regarding the use of Tyregrip® on WSDOT roadways.

Project Description

Tyregrip® was installed on the 014 S2 00793 Ramp (SE 164th Ave Southbound to SR 14 Westbound) at the approximate limits shown in Figure 1. SE 164th Avenue carries high volumes of traffic from the southeast Vancouver area heading westbound to connect with I-205 to Portland or SR-14 into downtown Vancouver. The length of the installation was 500 feet and the width 22 feet for a total of 1,200 square yards. Only the outside lane (Lane 2) and outside shoulder of the two lane ramp received the Tyregrip® treatment.

Figure 1. Approximate limits of Tyregrip® installation on SR 14 S2 00793 ramp.

Construction

The following will cover information related to the materials/equipment and construction process used to place the Tyregrip® product.

Materials/Equipment

Tyregrip®, as described previously, is composed of a two part epoxy based binder that is covered with aggregate. The aggregate is fractured 100 percent and is approximately No. 10 (2 mm) size material. For this project a machine application process was used which consists of a vehicle equipped with two feeder tanks (one for each epoxy component), a mixing unit, a spreader bar, and an aggregate containment system (Figure 2).

Figure 2. Vehicle used to mix and place epoxy binder and aggregates.

The containment tanks hold a thermoset two part epoxy which, when mixed together, create the epoxy based binder. These components are mixed at a ratio of 1:1. Component A is slightly thicker than Component B and is mixed at a temperature of 105 °F while Component B is mixed at 95 °F during production (Figure 3).

Figure 3. Temperature of Component A (left) and Component B (right) prior to production.

When the two components have been mixed, they are pumped through a series of hoses to the spreader bar (Figure 4). The 12-foot long spreader bar is vertically adjustable and is positioned approximately two inches from the pavement surface and allows the epoxy binder to flow uniformly onto the pavement at a rate of approximately 12 gallons per foot of travel.

Figure 4. Supply hoses and spreader bar prior to production.

Crushed bauxite or granite aggregate is then placed over the extruded epoxy in a manner similar to that of a bituminous surface treatment. The aggregate is loaded into a holding bin which feeds a spreader box located on the back of the application vehicle (Figure 5). According to the equipment operator, the rate of aggregate application varies but they try to place it in a manner where the epoxy will not quite bleed through. Figure 6 shows the aggregate being dropped on top of the extruded epoxy binder.

Figure 5. Aggregate in spreader box prior to production.

Figure 6. Aggregate dropping onto the extruded epoxy binder.

First Application

The first application took place on the night of August 30, 2010. The pavement surface was cleaned using two passes of a broom/vacuum vehicle prior to the application of the overlay. Roofing tar paper was placed at the startup and finish locations of the installation to prevent material from sticking to the pavement and to ensure that the distribution of the epoxy was uniform across the spreader bar prior to starting the section. Figure 7 shows the initial epoxy binder being extruded over the spreader bar and onto the roofing fabric.

Figure 7. Epoxy resin extruded over spreader plate onto roofing material at startup location.

Distribution of the aggregate was slightly uneven at the start of the placement because the left side of the spreader box didn't distribute sufficient aggregate to the left side of the lane. This was addressed by hand placing aggregate onto the epoxy binder. As the paving continued, distribution was rather consistent until there was a problem with the spreader that prevented placement of sufficient aggregate. As a result a rather large area didn't receive enough aggregate material. Again, hand placement was needed and at this location the aggregate was not as uniformly placed across the pavement surface. There were two other locations that required hand placement of the aggregate. Once all the equipment was operating correctly, placement of the aggregate on top of the epoxy binder was uniform. Figures 7 to 10 show the non-uniformity of the aggregate placement at various locations and Figure 11 an area with uniform aggregate placement. The plan was to place two lifts of material on the first night; however, due to problems with the equipment, the second lift was applied the following night.

Figure 8. Hand placement of aggregate at beginning of project.

Figure 9. Location where aggregate spreader limited placement of material.

Figure 10. Streaking surface caused by inconsistency of the aggregate spreader.

Figure 11. Illustration of uniform aggregate placement.

The second lift of the first application was placed on September 1, 2010. Figures 12 and 13 illustrate the condition of the surface prior to the second application of the Tyregrip®. The biggest problem with the first life was the lack of aggregate coverage mainly at the startup

location. The remaining areas of insufficient aggregate cover resulted in only slight surface irregularities as shown in Figure 13.

Figure 12. Startup location after first night placement.

Figure 13. Streaking in aggregate coverage.

Prior to placement of the second lift, the surface was again swept clean using the motorized broom/vacuum. Construction techniques were the same as the previous night. Rain between the two nights of construction resulted in the aggregate being substantially wetter than the first night. As a result the aggregate flowed less freely out of the spreader box the flow roller bar had to be continuously cleaned during placement. This resulted in slight streaks of epoxy which were immediately covered with aggregate by hand. This didn't appear to have any adverse effect on the surface (the epoxy binder was completely covered).

Friction Test Results

Friction testing was performed on the pavement surface prior to and after the Tyregrip® application. The pre-application friction numbers for the entire outside lane of the ramp, taken on May 20, 2010, averaged 47.4 with a range of 43.2 to 52.0. These friction results are not indicative of a low friction surface. The current policy directive (Appendix A) regarding low friction numbers indicates that locations with values under 30 will be retested. Solutions will be implemented for locations with values less than 26 following guidance provided by the Manual of Uniform Traffic Control Devices (MUTCD). Location with values between 26 and 30 will be evaluated for possible solutions again based on guidance from the MUTCD. This may indicate that high speeds and the sharp horizontal curve of the ramp are the leading cause of the high collision rates.

The post-application tests for the Tyregrip® performed on November 4, 2010, two months after the installation, averaged 54.1 with a range of 52.7 to 56.3. The friction numbers for the untreated portion of the ramp located before and after the Typrgrip® section averaged 44.1 with a range of 41.9 to 46.3. The modest increase in the friction numbers of the Tyregrip® section was very disappointing to the supplier and as a result they requested that WSDOT allow them to apply another coat at no cost provided WSDOT would supply the lane closure traffic control.

Second Application

The second application occurred on May 18, 2011. Note: Total Highway Maintenance (THM) was the company that placed the first and second applications described previously.

They were bought by Interstate Road Management Corporation (IRM) and then DeAngelo Brothers Incorporated bought and became the parent company of IRM.

The equipment and procedures for applying the material were the same as the previous applications. As with the first application, two passes were required to cover the lane and shoulder. The spreader bar and hoses are detached after each pass and discarded. New hoses and spreader bar are then placed onto the application vehicle and paving resumes after placing roofing fabric as noted above. The process of removing and replacing the spreader bar and hoses took approximately 45 minutes when conducted in 2010. This process only took 10 minutes when done by employees of IRM.

Two days prior to construction, the surface was cleaned using a broom/vacuum vehicle. On the night of installation, employees from IRM used a blower to remove excess debris from the roadway. When complete, roofing fabric was placed at the startup location of the roadway to collect errant material from coming in contact with the pavement and to ensure homogenous and even distribution of the epoxy.

At startup, distribution of the aggregate began a short distance after the start of the epoxy binder. This was addressed by hand placing aggregate onto the epoxy binder. Distribution of the aggregate was consistent throughout the remainder of the application which was completed within approximately 15 minutes. The Supervisor for IRM mentioned that they target an application rate of approximately 47 ft/min. For this section the target rate was slightly less because the material was being installed on a downhill corner with a significant super elevation. Although the installation was slower than that typically targeted, it was substantially faster than the two prior placements. Figures 14 to 20 capture the essence of the construction sequence.

Figure 14. Tar paper placed at the start of the 500 foot test section.

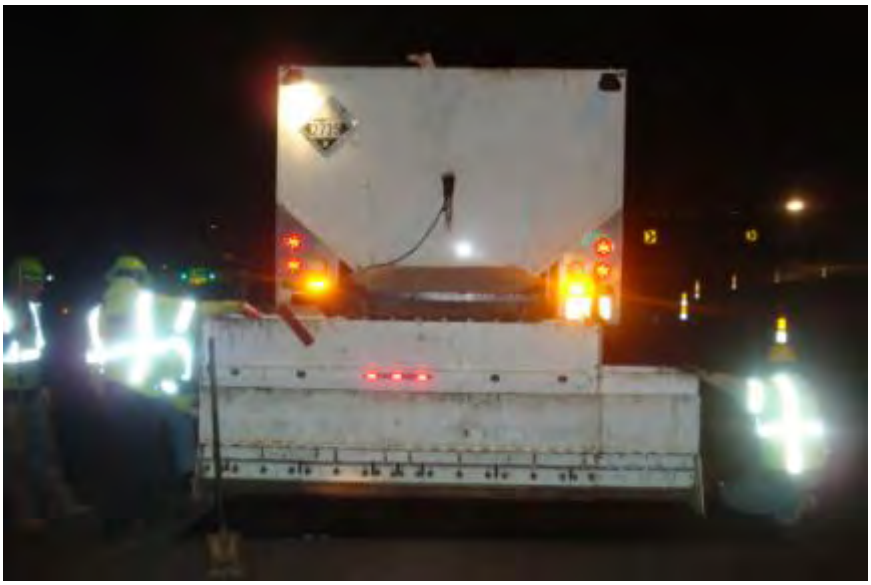

Figure 15. Application vehicle at start of the test section.

Figure 16. Calcined bauxite aggregate ready for distribution.

Figure 17. Aggregate in spreader box prior to production.

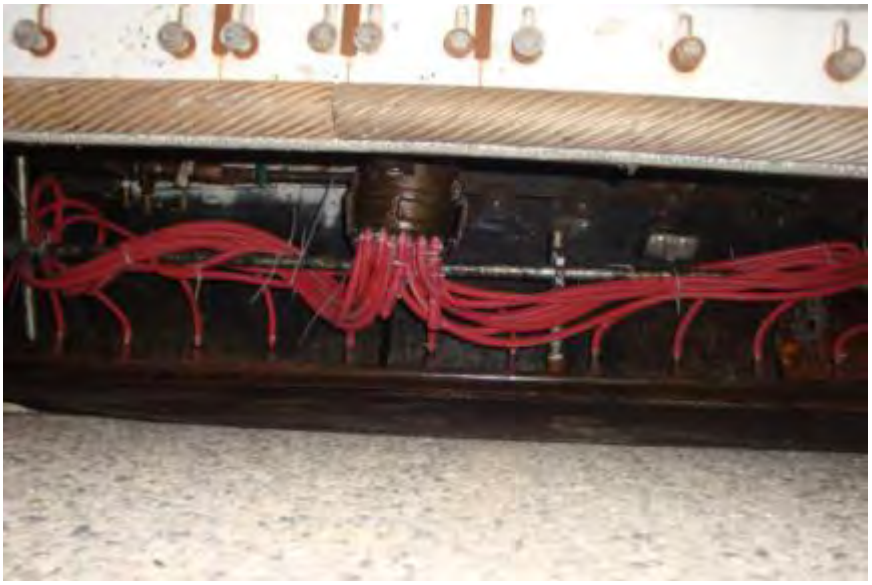

Figure 18. Multiple hoses used to distribute epoxy binder from the mixer to the spreader.

Figure 19. Aggregate being applied to epoxy after being placed on the pavement surface.

Figure 20. Close-up of spreader bar distributing epoxy binder and aggregate spreader dropping material on top of the epoxy.

Figure 21. Completed installation prior to the removal of the excess aggregate.

Friction Test Results

A second series of friction tests were run on May 31, 2011 to determine if the third application succeeded in increasing the friction resistance. The average friction number for the test section was 76.7 with a range of values from 75.7 to 79.3, a substantial increase over the measurements after the first and second applications.

The history of the friction results are summarized in Table 1. For the untreated section, the May 20, 2010 results are for the entire length of the ramp; the November 4, 2010 results taken after the first Tyregrip® application, are on the untreated portion of the ramp; and the May 31, 2011 results taken after the second Tyregrip® application, are again on the untreated portion of the ramp. For the Tyregrip® section the November 4, 2010 results are after the first application and the May 31, 2011 after the second application

Table 1. Summary of friction test results.

Location	Date	Average (FN)	Range (FN)
Untreated	May 20, 2010 (entire Lane 2)	47.4	43.2 – 52.0
	November 4, 2010 (portion of Lane 2)	44.1	42.0 – 46.3
	May 31, 2011 (portion of Lane 2)	44.5	38.3 – 47.9
Tyregrip®	November 4, 2010	54.1	52.7 – 56.3
	May 31, 2011	76.7	75.7 – 79.3

Cost

The price bid for the initial application was $43,800 before tax (see Appendix B). The section was 500 feet long and 22 feet wide for a total of 1,200 square yards. The cost was therefore $36.50 per square yard. The initial installation in 2010 was two lifts (75 mils, 13 lb/sy). The reinstallation in 2011 was only one lift (60 mils, 14 lb/sy). The cost is considerably higher than the Italgrip® used in Wisconsin which was indicated to cost $16 to $20 per square yard in 2008, however, the WSDOT installation may not be representative due to its small size.

Discussion of Results

The first and second application did not run as smoothly as planned and as a result a third application was needed in order to achieve the level of friction resistance promised by the supplier. This did not come as a surprise given WSDOT's experience with epoxy and methyl methacrylate bridge deck overlay systems. Overlay systems that use fast setting epoxy components are difficult to apply evenly. It is also difficult to get the correct amount and distribution of aggregates across the entire wetted surface of the binder. Inexperienced application personnel can result in applications that are not uniform leading to lower than expected friction resistance results. However, it appears that the third application had the equipment, materials and personnel needed to successfully achieve a uniform application with sufficient aggregate cover to provide an improved level of friction resistance for this ramp.

Future Research

The test section will be friction tested and visually evaluated on a yearly basis for a minimum of five years as noted in the Experimental Feature Work Plan (Appendix C). Collision data will be collected and analyzed for the same five year period. At the end of the five-year period, a final report will be written which summarizes the friction and performance characteristics of the application, its effectiveness at reducing collisions, and recommendations on the future use of the Tyregrip® process.

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Appendix A

Skid Accident Reduction Program

Interim Directive ID 55-77

Department of Transportation

INTERIM DIRECTIVE ID 55-77

Effective Date:

September 29, 1994

/s/ E. R. Burch
Assistant Secretary for Environmental
and Engineering

/s/ John F. Conrad
Assistant Secretary for Field Operations
Support

Skid Accident Reduction Program

I. **Introduction**

A. **Purpose**

To provide guidance for use of pavement friction measurements generated by the Olympia Service Center Materials Laboratory.

B. **Supersession**

"WSDOT Skid Accident Reduction Program" Position Statement, dated April 7, 1976 is hereby superseded.

II. **Background**

The October 5, 1992 amendment to the December 1991 federal aid Policy Guide Section 23 CFR 626.5 suggests that each state's skid accident reduction program should include ". . . a systematic process to identify, analyze, and correct hazardous skid locations."

In reviewing the current literature available on friction testing and skid accident location identification, there are some limited studies that suggest apparent correlation between wet-weather accident rates and skid numbers less than 26. No studies were found that suggest a correlation between wet-weather accident rates and skid numbers of 26 or greater. This information has been considered in establishing the current skid accident reduction program.

The current literature maintains that accident histories are the best indicators of the cause of wet-weather accidents. Wet-pavement accidents may be caused by complex interactions among many roadway, vehicle, human, and environmental factors. Accidents also may occur because of unpredictable factors and random variables such as unforeseen events or obstacles.

ID 55-77

III. **Policy**

The purpose of WSDOT's skid accident reduction program is to minimize wet weather skidding accidents.

IV. **Rules**

A. As an aid in identifying potential skid accident locations, every Washington State highway shall be tested every two years for skid resistance at one-mile intervals.

B. Locations with skid numbers at or below 30 shall be retested.

C. WSDOT uses two primary sources for identifying and ranking statewide safety needs: crash history analysis and roadway geometric/condition modeling that includes skid number assessment. Skid numbers shall be considered in the development of appropriate solutions to address both accident and potential accident locations.

D. Solutions will be implemented for locations with skid numbers below 26. Some of the data published in certain current studies show some correlation between wet-weather accident rates and skid numbers less than 26, therefore the guidance provided in the MUTCD shall be followed when determining if such locations should be signed "Slippery When Wet."

E. Locations with skid numbers of 26 to 30 will be evaluated. Because of continuing questions and concerns regarding the accuracy and repeatability of the friction testing procedures, and the possibility of a decrease in the skid number during the time period between testing, the guidance provided in the MUTCD shall be followed when determining if locations with skid numbers of 26 through 30 should be signed "Slippery When Wet."

V. **Procedures**

Action By	Action
Materials Laboratory	1. Tests Pavement Friction at one-mile intervals throughout the state highway system on two-year cycles. Tests all pavements newly constructed no earlier than one month after placement or by the end of the construction season. All locations with a single Skid Number (SN) of 30 and below will be retested promptly. (Retesting shall consist of five friction tests taken within one quarter mile of the point of the single test with a SN of 30 or less and the average of such tests shall be used as the SN for regional review.)
	2. Distributes test results to the Transportation Data Office and to Regional Administrators.

ID 55-77

Action By	Action
Regional Administrator	3. Forwards test results to Regional Operations Engineer. a. If a Region does not have an Operations Engineer, designates a position authorized to carry out the responsibilities of the Regional Operations Engineer and notifies Assistant Secretary.
Regional Operations Engineer	4. Reviews test results and does the following: a. For those friction tests with SN at or below 30, informs and reviews results with Regional Maintenance and Traffic Engineers and b. Reviews locations which have been previously tested with SN at or below 30 for consistency with current test results. Checks on whether or not adverse accident history has developed at such locations and if so, whether or not improvements have been scheduled or completed.
Regional Maintenance Area Superintendent and Regional Traffic Engineer	5. Participate in joint field review at each site with SN at or below 30, take the appropriate action as specified below, document, and report back to Operations Engineer a. At all locations with SN below 26 and as conditions indicate for locations with SN of 26 through 30 take action as described below:
Regional Traffic Engineer	1) Analyzes traffic data records to determine high or potentially high wet weather accident rates in those areas testing at or below 30. 2) At locations where crash rate or roadway/roadside modeling indicates that a problem exists, recommends solutions to Regional Operations Engineer unless problems have been corrected by Maintenance.
Regional Maintenance Area Superintendent	3) When conditions indicate, erects “Slippery When Wet” signs at each site with an average SN at or below 30 4) May also take other immediate corrective action.

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ID 55-77

Action By	Action
Regional Maintenance Area Superintendent and Regional Traffic Engineer	b. At locations with SN of 26 through 30 and when conditions indicate, recommend no action.
Regional Operations Engineer	6. At locations where construction improvements are warranted, does one of the following: a. Coordinates construction with Regional Maintenance Area Superintendent. See Step 7. b. Coordinates construction with Regional Program Management and Regional Project Development for possible future construction. See Step 8.
Regional Maintenance Area Superintendent	7. Constructs (with state forces or by contract) appropriate surface treatment to improve skid resistance. If "Slippery When Wet" signing has been installed, removes it when the project is complete, and informs Regional Traffic Engineer.
Regional Program Management	8. At the locations having low SN and a high accident rate to which Maintenance has not made alterations, programs suitable improvements.

VI. Alternate Formats

Persons with disabilities may request this information be prepared and supplied in alternate forms by calling collect (206) 664-9009. Deaf and hearing impaired people call 1-800-833-6388 (TTY relay service).

VII. Appendix

1. References

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Appendix B

Contract Execution Letter

July 27, 2010

Total Highway Maintenance, LLC
930 KCK Way
Cedar Hill, TX 75104

RE: Agreement Number DD-353
SR 14 & 164th Avenue SB to WB On-Ramp
High Friction Surfacing
State Project
Clark County

Ladies & Gentlemen:

This is to inform you the contract for the above-referenced project was awarded to your firm at your bid price of $43,800 before taxes. The Agreement was executed on July 27, 2010.

Per the Contract Provisions, the work shall commence no later than September 1, 2010.

Notify us about your planned work schedule in advance, so our traffic control crews can get ready.

If you have any questions, please contact Dave Burkey at (360)905-2262.

Sincerely,

Chad E. Hancock, P.E.
SW Region Traffic Engineer

CEH/js
Enclosure

cc: Roberta Funkhouser, SW Region Accounting

Appendix C

Experimental Feature Work Plan

Washington State Department of Transportation

WORK PLAN

Tyregrip® Evaluation

State Route 14
SE 164th Ave Interchange
Milepost 7.93 to Milepost 8.90
014 S2 00793 Ramp
(SE 164th Ave Southbound to SR 14 Westbound)

Mark A. Russell
Pavement Design Engineer
Washington State Department of Transportation

Introduction

The 014 S2 00793 ramp carries traffic merging onto westbound SR 14 from southbound SE 164th Ave. Traffic on the ramp must negotiate a curve to the right before merging onto SR 14. Twenty seven accidents in three years have been recorded on this curve making it a High Accident Location (HAL). To reduce accidents, WSDOT installed warning signs to alert motorists to the hazard but there is still a high occurrence of accidents. The majority of the accidents were single vehicle with 20 of the 27 occurring during wet weather. The ramp geometry and type of accidents indicate that increasing the pavement friction may reduce the number of accidents.

There are several methods to increase friction on an existing HMA pavement. These include replacing the pavement, placing a surface treatment such as a chip seal over the existing pavement or grooving the pavement by diamond grinding. These methods are costly and the existing HMA pavement on the ramp is not due for rehabilitation. A less costly solution is to install a thin high-friction laminate surface over the existing pavement.

One thin high-friction surface laminate material is ®. Tyregrip® is a thin polymer and aggregate surfacing material consisting of a highly modified two part epoxy resin. Tyregrip is usually top dressed with calcined bauxite which is a durable aggregate that also has good friction characteristics. Other agencies have used Tyregrip® to improve friction but this will be the first use by WSDOT. This experimental feature will document the construction and performance of Tyregrip.

Scope

Tyregrip® will be installed on the 014 S2 00793 Ramp (SE 164th Ave Southbound to SR 14 Westbound) at the approximate limits shown in Figure 1. The length of the installation will be approximately 500 feet.

Figure 1. Approximate limits of Tyregrip® installation on SR 14 S2 00793 ramp.

Staffing

This installation will be constructed as a Southwest Region Traffic Operations project. Therefore the Region Traffic office will coordinate and manage all construction aspects. Representatives from and WSDOT Materials Laboratory (1 – 2 people) will also be involved with the process.

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Testing

Pavement performance will be monitored by the following methods:

- Friction will be measured before and after construction then annually.
- Accident data will be gathered by the Southwest Region Traffic Office

Reporting

A "Post Construction Report" will be written following completion of the test section. This report will include construction details, cost of the treatment, construction test results, and other details concerning the overall process. Annual summaries will also be conducted over the next five years. At the end of the five-year period, a final report will be written which summarizes the performance characteristics, effectiveness at reducing accidents and future recommendations for use of this process.

Cost Estimate

Construction Costs

No additional construction costs are required. This project will be constructed as a Region HAL enhancement (Q2 program) project.

Testing Costs

Pre-construction friction testing will be conducted as part of the Region Q program project (estimated cost $2,500). Post construction testing will be conducted in conjunction with scheduled post construction testing of HMA preservation projects.

Report Writing Costs

Initial Report – 16 hours = $1,600

Annual Report – 5 hours (1 hour each) = $500

Final Report – 32 hours = $3,200

TOTAL COST = $10,300

Schedule

Construction: June – July 2010

Date	Friction (Annual)	Post Construction Report	Annual Report	Final Report
Spring 2010	X			
Fall 2010	X	X		
Fall 2011	X		X	
Fall 2012	X		X	
Fall 2013	X		X	
Fall 2014	X		X	
Spring 2015				X