



State of West Virginia
 Department of Administration
 Purchasing Division
 2019 Washington Street East
 Post Office Box 50130
 Charleston, WV 25305-0130

Request for Quotation

RFO NUMBER
7770095

PAGE
1

ADDRESS CORRESPONDENCE TO ATTENTION OF:
**MICHAEL AUSTIN
 304-558-2316**

VENDOR

RFQ COPY
 TYPE NAME/ADDRESS HERE

SHIP TO

DIVISION OF HIGHWAYS
 MATERIALS, CONTROL, SOILS,
 & TESTING
 190 DRY BRANCH DRIVE
 CHARLESTON, WV
 25306 304-558-8984

| DATE PRINTED | TERMS OF SALE | SHIP VIA | F.O.B. | FREIGHT TERMS |
|------------------------------|---------------|--------------------------|--------|---------------|
| 08/19/2007 | | | | |
| BID OPENING DATE: 09/12/2007 | | BID OPENING TIME 01:30PM | | |

| LINE | QUANTITY | UOP | CAT. NO. | ITEM NUMBER | UNIT PRICE | AMOUNT |
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| 0001 | 1 | EA | | 845-63 | | |
| PAVEMENT FRICTION TESTER TO PROVIDE A PAVEMENT SKID FRICTION TEST SYSTEM PER THE ATTACHED SPECIFICATION. VENDOR PREFERENCE CERTIFICATE CERTIFICATION AND APPLICATION* IS HEREBY MADE FOR PREFERENCE IN ACCORDANCE WITH WEST VIRGINIA CODE, 5A-3-37 (DOES NOT APPLY TO CONSTRUCTION CONTRACTS). A. APPLICATION IS MADE FOR 2.5% PREFERENCE FOR THE REASON CHECKED: <input type="checkbox"/> BIDDER IS AN INDIVIDUAL RESIDENT VENDOR AND HAS RESIDED CONTINUOUSLY IN WEST VIRGINIA FOR FOUR (4) YEARS IMMEDIATELY PRECEDING THE DATE OF THIS CERTIFICATION; OR <input type="checkbox"/> BIDDER IS A PARTNERSHIP, ASSOCIATION OR CORPORATION RESIDENT VENDOR AND HAS MAINTAINED ITS HEAD-QUARTERS OR PRINCIPAL PLACE OF BUSINESS CONTINUOUSLY IN WEST VIRGINIA FOR FOUR (4) YEARS IMMEDIATELY PRECEDING THE DATE OF THIS CERTIFICATION; OR 80% OF THE OWNERSHIP INTEREST OF BIDDER IS HELD BY ANOTHER INDIVIDUAL, PARTNERSHIP, ASSOCIATION OR CORPORATION RESIDENT VENDOR WHO HAS MAINTAINED ITS HEADQUARTERS OR PRINCIPAL PLACE OF BUSINESS CONTINUOUSLY IN WEST VIRGINIA FOR FOUR (4) YEARS IMMEDIATELY PRECEDING THE DATE OF THIS CERTIFICATION; OR | | | | | | |

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**GENERAL TERMS & CONDITIONS
REQUEST FOR QUOTATION (RFQ) AND REQUEST FOR PROPOSAL (RFP)**

1. Awards will be made in the best interest of the State of West Virginia.
2. The State may accept or reject in part, or in whole, any bid.
3. All quotations are governed by the *West Virginia Code* and the *Legislative Rules* of the Purchasing Division.
4. Prior to any award, the apparent successful vendor must be properly registered with the Purchasing Division and have paid the required \$125.00 registration fee.
5. All services performed or goods delivered under State Purchase Orders/Contracts are to be continued for the term of the Purchase Order/Contract, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise available for these services or goods, this Purchase Order/Contract becomes void and of no effect after June 30.
6. Payment may only be made after the delivery and acceptance of goods or services.
7. Interest may be paid for late payment in accordance with the *West Virginia Code*.
8. Vendor preference will be granted upon written request in accordance with the *West Virginia Code*.
9. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.
10. The Director of Purchasing may cancel any Purchase Order/Contract upon 30 days written notice to the seller.
11. The laws of the State of West Virginia and the *Legislative Rules* of the Purchasing Division shall govern all rights and duties under the Contract, including without limitation the validity of this Purchase Order/Contract.
12. Any reference to automatic renewal is hereby deleted. The Contract may be renewed only upon mutual written agreement of the parties.
13. **BANKRUPTCY:** In the event the vendor/contractor files for bankruptcy protection, this contract is automatically null and void, and is terminated without further order.
14. **HIPAA Business Associate Addendum -** The West Virginia State Government HIPAA Business Associate Addendum (BAA), approved by the Attorney General, and available online at the Purchasing Division's web site (<http://www.state.wv.us/admin/purchase/vrc/hipaa.htm>) is hereby made part of the agreement. Provided that, the Agency meets the definition of a Covered Entity (45 CFR §160.103) and will be disclosing Protected Health Information (45 CFR §160.103) to the vendor.

INSTRUCTIONS TO BIDDERS

1. Use the quotation forms provided by the Purchasing Division.
2. **SPECIFICATIONS:** Items offered must be in compliance with the specifications. Any deviation from the specifications must be clearly indicated by the bidder. Alternates offered by the bidder as **EQUAL** to the specifications must be clearly defined. A bidder offering an alternate should attach complete specifications and literature to the bid. The Purchasing Division may waive minor deviations to specifications.
3. Complete all sections of the quotation form.
4. Unit prices shall prevail in cases of discrepancy.
5. All quotations are considered F.O.B. destination unless alternate shipping terms are clearly identified in the quotation.
6. **BID SUBMISSION:** All quotations must be delivered by the bidder to the office listed below prior to the date and time of the bid opening. Failure of the bidder to deliver the quotations on time will result in bid disqualifications.

SIGNED BID TO:

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130



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| <p>() BIDDER IS A CORPORATION NONRESIDENT VENDOR WHICH HAS AN AFFILIATE OR SUBSIDIARY WHICH EMPLOYS A MINIMUM OF ONE HUNDRED STATE RESIDENTS AND WHICH HAS MAINTAINED ITS HEADQUARTERS OR PRINCIPAL PLACE OF BUSINESS WITHIN WEST VIRGINIA CONTINUOUSLY FOR THE FOUR (4) YEARS IMMEDIATELY PRECEDING THE DATE OF THIS CERTIFICATION.</p> <p>B. APPLICATION IS MADE FOR 2.5% PREFERENCE FOR THE REASON CHECKED:</p> <p>() BIDDER IS A RESIDENT VENDOR WHO CERTIFIES THAT, DURING THE LIFE OF THE CONTRACT, ON AVERAGE AT LEAST 75% OF THE EMPLOYEES WORKING ON THE PROJECT BEING BID ARE RESIDENTS OF WEST VIRGINIA WHO HAVE RESIDED IN THE STATE CONTINUOUSLY FOR THE TWO YEARS IMMEDIATELY PRECEDING SUBMISSION OF THIS BID;</p> <p>OR</p> <p>() BIDDER IS A NONRESIDENT VENDOR EMPLOYING A MINIMUM OF ONE HUNDRED STATE RESIDENTS OR IS A NONRESIDENT VENDOR WITH AN AFFILIATE OR SUBSIDIARY WHICH MAINTAINS ITS HEADQUARTERS OR PRINCIPAL PLACE OF BUSINESS WITHIN WEST VIRGINIA EMPLOYING A MINIMUM OF ONE HUNDRED STATE RESIDENTS WHO CERTIFIES THAT, DURING THE LIFE OF THE CONTRACT, ON AVERAGE AT LEAST 75% OF THE EMPLOYEES OR BIDDERS' AFFILIATE'S OR SUBSIDIARY'S EMPLOYEES ARE RESIDENTS OF WEST VIRGINIA WHO HAVE RESIDED IN THE STATE CONTINUOUSLY FOR THE TWO YEARS IMMEDIATELY PRECEDING SUBMISSION OF THIS BID.</p> <p>BIDDER UNDERSTANDS IF THE SECRETARY OF TAX & REVENUE DETERMINES THAT A BIDDER RECEIVING PREFERENCE HAS FAILED TO CONTINUE TO MEET THE REQUIREMENTS FOR SUCH PREFERENCE, THE SECRETARY MAY ORDER THE DIRECTOR OF PURCHASING TO: (A) RESCIND THE CONTRACT OR PURCHASE ORDER ISSUED; OR (B) ASSESS A PENALTY AGAINST SUCH</p> | | | | | | |

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| <p>BIDDER IN AN AMOUNT NOT TO EXCEED 5% OF THE BID AMOUNT AND THAT SUCH PENALTY WILL BE PAID TO THE CONTRACTING AGENCY OR DEDUCTED FROM ANY UNPAID BALANCE ON THE CONTRACT OR PURCHASE ORDER.</p> <p>BY SUBMISSION OF THIS CERTIFICATE, BIDDER AGREES TO DISCLOSE ANY REASONABLY REQUESTED INFORMATION TO THE PURCHASING DIVISION AND AUTHORIZES THE DEPARTMENT OF TAX AND REVENUE TO DISCLOSE TO THE DIRECTOR OF PURCHASING APPROPRIATE INFORMATION VERIFYING THAT BIDDER HAS PAID THE REQUIRED BUSINESS TAXES, PROVIDED THAT SUCH INFORMATION DOES NOT CONTAIN THE AMOUNTS OF TAXES PAID NOR ANY OTHER INFORMATION DEEMED BY THE TAX COMMISSIONER TO BE CONFIDENTIAL.</p> <p>UNDER PENALTY OF LAW FOR FALSE SWEARING (WEST VIRGINIA CODE 61-5-3), BIDDER HEREBY CERTIFIES THAT THIS CERTIFICATE IS TRUE AND ACCURATE IN ALL RESPECTS; AND THAT IF A CONTRACT IS ISSUED TO BIDDER AND IF ANYTHING CONTAINED WITHIN THIS CERTIFICATE CHANGES DURING THE TERM OF THE CONTRACT, BIDDER WILL NOTIFY THE PURCHASING DIVISION IN WRITING IMMEDIATELY.</p> <p>BIDDER: -----</p> <p>DATE: -----</p> <p>SIGNED: -----</p> <p>TITLE: -----</p> <p>* CHECK ANY COMBINATION OF PREFERENCE CONSIDERATION(S)</p> | | | | | | |

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| <p>IN EITHER "A" OR "B", OR BOTH "A" AND "B" WHICH YOU ARE ENTITLED TO RECEIVE. YOU MAY REQUEST UP TO THE MAXIMUM 5% PREFERENCE FOR BOTH "A" AND "B". (REV. 12/00)</p> <p style="text-align: center;">NOTICE</p> <p>A SIGNED BID MUST BE SUBMITTED TO:</p> <p style="text-align: center;">DEPARTMENT OF ADMINISTRATION PURCHASING DIVISION BUILDING 15 2019 WASHINGTON STREET, EAST CHARLESTON, WV 25305-0130</p> <p>THE BID SHOULD CONTAIN THIS INFORMATION ON THE FACE OF THE ENVELOPE OR THE BID MAY NOT BE CONSIDERED:</p> <p>SEALED BID</p> <p>BUYER: 43</p> <p>RFQ. NO.: 7770054</p> <p>BID OPENING DATE: 09/12/2007</p> <p>BID OPENING TIME: 1:30 PM</p> <p>PLEASE PROVIDE A FAX NUMBER IN CASE IT IS NECESSARY TO CONTACT YOU REGARDING YOUR BID:</p> <p>-----</p> | | | | | | |

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| CONTACT PERSON (PLEASE PRINT CLEARLY): | | | | | | |
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| ***** THIS IS THE END OF RFQ 7770095 ***** TOTAL: | | | | | | _____ |

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1.0 SYSTEM DESCRIPTION

The Pavement Skid Friction Test System measures the coefficient of friction of pavements using a Locked Wheel in accordance with ASTM standard E274.

The system consists of a specially equipped vehicle and a specially equipped towed two-wheeled trailer.

The trailer uses an ASTM standard ribbed or blank test tire, which can be pulled over a paved surface by the truck at a constant velocity while a nozzle dispenses water in front of the tire to simulate wet conditions. The test wheel of the trailer is coupled by a disc brake assembly to a calibrated force transducer, which measures the traction force and load on the wheel under braking. The electrical/mechanical devices in the trailer are controlled by the computer system electronics in the pickup truck in combination with switches on an operator's control console.

The truck cab contains an on-board computer system that controls all skid friction testing operations and performs all necessary data logging functions. The computer system, herein referenced as the Mobile Data Recorder (MDR), in conjunction with the remaining components of Pavement Skid Friction Test System is capable of:

- (1) Interfacing with the operator
- (2) Controlling the tests
- (3) Measuring and digitizing the necessary resultant test signal data
- (4) Recording the resultant test data on IBM-PC compatible media
- (5) Calculating and storing the friction values
- (6) Displaying the stored digitized friction data
- (7) Printing the stored data upon operator request

when conducting tests to measure the friction characteristics of paved surfaces using a full-scale tire in accordance with ASTM E274, Standard Test Method for Skid Resistance of Paved Surfaces Using a full-scale Tire.

The vehicle contains a water system which supplies water to the test trailer, an air system to provide control assistance, electronics to control the test operations, electrical equipment to supply the required DC power to the test system, and a computer system to activate tests and record the measured data.

In typical testing, the driver of the truck maintains the desired test speed then activates a test where the equipment (1) dispenses water at the trailer wheel, (2) actuates the trailer braking system to lock up the wheel, (3) detects the resultant wheel traction force, wheel load, and vehicle speed and (4) uses the resulting force time information to determine the friction of pavement for the standard test tire. The friction value detected can be recorded with the milepost where the test was activated.

The ASTM specification requires only single wheel testing and the equipment users only test with one wheel.

All connections between the vehicle and the trailer are quick disconnect to allow easy and complete separation of the vehicle from the trailer. The static download at the hitch point is designed to be 100 to 200 pounds. The static download at each test wheel is designed to be 1,085 +/- 15 pounds. A third adjustable height support wheel is located on the trailer near the tongue to support the front of the trailer when disconnected from the truck.

2.0 TRAILER DESCRIPTION

The trailer completely disconnects from the truck. This is easily accomplished via quick disconnects and hand tight screw fittings. The trailer has a front compartment which houses a spare tire and electrical components plus a rear compartment which contains the air and hydraulic brake control equipment. Gas shocks are used to assist the opening and closing of the aluminum covers over each compartment. The covers provide easy access while creating environmental protection. Four flashing lights are provided on the trailer rear cover. Two flexible antennas are mounted on the rear bumper to indicate the rear position of the trailer. Corvette type disk brakes are used to provide quick lockups during testing.

2.1 TRAILER CONSTRUCTION

The trailer has a perimeter type frame constructed of two by four inch rectangular box sectional steel tubing. The tongue is a four-inch box section with a two-inch ball coupler. The construction gives solid rigidity with low weight for minimum wheel load. Weights are added to bring the trailer load at the wheels into ASTM specifications. A third adjustable height support wheel is located on the trailer tongue area to support the front of the trailer when disconnected from the truck.

2.2 TRAILER SUSPENSION

The trailer suspension is a parallelogram trailing arm design, with adjustable upper control arms and fixed lower control arms on each side. Pivot points are hard spherical bushing or universal joints to minimize rotation of the axle and provide free motion. Coil springs, air adjustable shocks, and an adjustable anti-sway bar complete the suspension components. The suspension system shall allow any transducer cross-talk to be removed without touching the transducer's mounting hardware.

2.3 TRAILER TRANSDUCERS

The trailer contains transducers to measure wheel speed, traction, load, and provides control for braking and optional water flow in a two-wheel system.

2.3.1 TRAILER WHEEL SPEED TRANSDUCERS

The speed of each trailer wheel is measured by a special digital pulse generator located on the outside of each rotor. The DMI reads pulses created by precisely machined notches in the rotor. The DMI is fully contained outside the axle/spindle assembly. The DMI is capable of being fully serviced without removing the spindle assemblies from the trailer. The speed resolution

and accuracy is +/- 0.1% per mile. The speed signals are routed to the electronics in the vehicle cab and viewable on both the computer screen and a dash mounted digital voltmeter. The speed of both wheels is simultaneously recorded at the time of rest.

2.3.2 TRAILER FORCE/LOAD TRANSDUCERS

The transducers that measure force and load at each wheel are strain gage bridges mounted on a single stainless steel assembly. The transducer is mounted between the spindle and the wheel assemblies and an instrumentation connector is used to connect to the trailer wiring. The bridge requires that voltage be applied across it during operation and that its output be amplified from microvolt levels to that required by the data acquisition equipment. The trailer wiring routes the signals to the truck connectors and forward to the computer/electronics which provides all voltages and signals conditioning. Transducer/Bridges may be present at either or both wheels as required but only one shall be selected at a time.

The transducer measures force in two orthogonal directions and must be oriented so these directions are along the road surface and perpendicular to the road surface. The orientation is accomplished by slotted hole with four locking bolts to insure alignment with the trailer tongue. After alignment the force transducers are protected by means of a stone shield, straps, and tape.

The calibrated transducer is designed to meet the requirements ASTM E274. It will have less than 1% non-linearity and hysteresis when subjected to torsion load only, and less than 1% cross-talk under 1,000 lbs. load in bending. Calibration shunt resistors are contained in the computer system for monitoring the signal calibration.

2.4 TRAILER BRAKING SYSTEM

The braking system is air over hydraulics and provides two pressures. A lower safety brake pressure is applied to both brakes for normal stopping which a separate high pressure can be applied to the wheel during testing. Corvette disk brakes are used to provide quick lockups.

3.0 TOW VEHICLE DESCRIPTION

The tow vehicle is a one ton dual rear-wheel extended cab pickup truck. The vehicle supports up to a 300-gallon water tank fully loaded and has enough power to perform testing fully loaded at speeds up to the maximum speed limit allowed by law on a level terrain.

The tow vehicle supplies all the mechanical and electrical power required to perform testing and contains several support systems. The support systems include the electrical system, the watering system, the air compressor/storage system, and the Computer/Electronics System.

Standard WVDOT vehicle paint color is white. The vehicle also contains a spare truck tire and a fiberglass bed cover.

Training – 2 days of on-site training of operators and maintenance crews will be included. (Training to be conducted at WVDOT facilities in Charleston, West Virginia)

Include a GPS system so test locations can be mapped and entered in the Departments GIS system.

System will be delivered to the following address:

WVDOT
190 Dry Branch Road
Charleston, West Virginia 25306

3.1 ELECTRICAL SYSTEM

The electrical system consists of a System Control Panel, a trailer mounted digital capture system, an aux. battery, a cab roof mounted warning light, a speaker system, a connector panel at the rear bumper and a main wiring harness.

3.1.1 SYSTEM CONTROL PANEL

The system control panel is located to the right of the driver under the monitor easily accessible to the driver/operator. The control panel houses components including the operator switches, control relays, terminal blocks, fuses, etc., which provide the most basic power control functions. The main control functions are provided by the computer system via the control panel wiring. The floppy disk drives are also conveniently located on the system control panel.

Switches and indicators which the operator can use are mounted on the front of the control panel. The switches and indicator are as follows:

- (1) **Power Switch** – Turns on the power to the computer system and electronic power supplies.
- (2) **Air Pump/Aux Power Switch** – Applies DC power to the air compressor, and DC components in the truck and trailer. Must be on to maintain air in reservoir (tank) for brake application for both manual and computer operation.
- (3) **Air On Light** – Indicates air compressor is on.
- (4) **Safety Brake Switch** – Manually applies safety brakes to the trailer.
- (5) **Cycle Start** – An automatic cycle may be initiated by depressing push button.
- (6) **Remote Cycle Start** – External jack on side of control panel where cord with hand held push button may be plugged in to allow cycle start.
- (7) **Cycle Kill/Stop Push-Button** – Actuation stops the automatic cycle when desired.
- (8) **Beacon and Flashers On/Off** – turns on truck beacon and trailer flashers.

(9) **Jacks Power** – Supply power so trailer jacks may be used.

(10) **Water Level** – Indicator lights that display the amount of water located in the water tank. (Top, Mid, Bottom)

3.1.2 WARNING LIGHT

A warning light powered from the standard vehicle battery is mounted on the truck cab roof, which may be turned on via the control panel.

3.1.3 REAR BUMPER CONNECTOR PANEL

Screw type waterproof connectors are provided at the rear bumper to allow the truck and trailer to easily be disconnected. One connector is provided for control signals and lighting which the second is provided for data signals.

3.1.4 MAIN WIRING HARNESS

The main wiring harness is contained in conduit and connects the truck cab area to the truck bed and rear bumper connector panel. Spare wires are provided which all used wires are terminated in connectors or terminals.

3.2 WATERING SYSTEM

The watering system consists of a water tank mounted in the vehicle, water-pumping unit mounted under the vehicle, and plumbing under the vehicle.

3.2.1 WATER TANK

The water tank is either a 250-350 gallon tank constructed of welding aluminum. The tank contains baffles and an overflow for proper water handling. The tank top is screwed down to the side panels and sealed with a silicon sealer to prevent leaks. The top may be removed for complete access to the tank. An optional water level indicator provides a minimum of three water level indications.

3.2.2 WATER PUMPING UNIT

The water-pumping unit is driven from the drive shaft of the vehicle using a gear belt pulley and electrical clutch. The output of the clutch drives a positive displacement pump, which provides water under computer control via the electric clutch activation. An adjustable driven balancing gear unit is used to eliminate vibration at the drive shaft. A petcock valve is provided at the pump to provide water pump drainage. All water delivery components are mounted to pillow blocks, which ride on a cradle assembly. The components are tied together with a special adjustment rod, which adjusts all components simultaneously.

3.2.3 PLUMBING

The plumbing consists of all rust free components of either brass, stainless steel, or rubber tubing. A strainer and dump valve are located at the tank output near the vehicle side for ease of use. A Hansen quick disconnect fitting is used at the rear bumper to allow for the easy separation of vehicle and trailer.

3.3 AIR COMPRESSOR/STORAGE SYSTEM

The air compressor/storage system consist of a compressor system mounted in the vehicle and two air storage tanks mounted under the vehicle in the rear providing 20 gallons of air storage. The system contains a filter, dryer, control valve, safety valve and oiler in the supply airline. A quick disconnect fitting is provided at the vehicle bumper for easy connection to the trailer. A drain is provided on each tank.

4.0 COMPUTER/ELECTRONICS SYSTEM GENERAL DESCRIPTION

The computer system is mounted between the seats in the tow vehicle cab while the analog to digital conversion electronics are mounted in a protective enclosure in the trailer. All signals from sensing devices in the skid trailer are converted into digital signals in the trailer and sent to the recording electronics in the vehicle cab. The trailer mounted digital conversion eliminates any potential signal loss or device error due to wiring harness length.

The distance measurement is accomplished using a pulse generator mounted in the transmission or the rear differential assembly of the vehicle. The system has a method of calibration to ensure accurate measurement of roadway distance. The accuracy of the system can be calibrated to $\pm 0.1\%$ per mile.

The system supplied for friction testing performs in a real-time, interactive, vehicle environment, which may include a two-way radio, flashing lights, speaker system, and other potential noise sources. The equipment when combined with the sensors on the trailer and transport vehicle tracks the location of the test vehicle, controls the friction tests being performed, displays the test results, and displays vehicle location on the system monitor. Collection and display of roadway feature data and friction test data shall occur in real-time.

4.1 GENERAL DESIGN PARAMETERS

The system is designed to meet the following general requirements:

- (a) The system operates satisfactorily in the rugged environment of the transport vehicle used for friction testing.
- (b) The system operates satisfactorily in all typical climatic conditions when installed in the transport vehicle.

- (c) The system allows testing to be safely performed in the field without hindrance to on-going traffic.
- (d) The system integrity or location measurement accuracy is not compromised and testing may be performed at vehicle speeds up to 65 MPH.
- (e) The system is capable of storing test results and measured feature locations in real-time.
- (f) The system measures data in feet, kilometers, or miles in an incrementing or decrementing mode from an arbitrary starting point.
- (g) Operating temperature range is 34 to 110 degrees F, non-operating temperature range shall be 32 to 140 degrees F.
- (h) Operating temperature range is 8% to 80% (non-condensing), non-operating humidity range is 5% to 95% (non-condensing) non-operating.
- (i) Operating power is +12VDC @ 30A supplied by test vehicle electrical system. Vehicle DC is converted to 110 VAC for required components.

4.2 COMPONENTS AND BLOCK DIAGRAM

All test activities are automated by and consolidated in the database management, vehicle location tracking, friction testing, data display.

The system utilizes an IBM-PC at compatible microcomputer with a SVGA controller for high resolution graphics, USB drive, a CDRW drive and a hard drive as the Processing Unit.

4.2.1 COMPUTER SYSTEM

The computer system meets the following minimum specifications:

- (a) IBM-PC at compatible system – Pentium microprocessor based design using a single industrial hardened processor board with:
 - 1) 128 Mbytes of RAM memory
 - 2) Two RS-232C Serial Ports (One is dedicated to DAS)
 - 3) One IBM compatible Parallel Port
 - 4) One CDRW
 - 5) Battery-backed up real-time Clock
 - 6) USB Drive and Hard disk
- (b) Windows XP operating system
- (c) USB drive

- (d) A high resolution SVGA graphics controller
- (e) A 200 Gbyte minimum hard disk drive
- (f) Power requirements: 110 VAC

The configuration contains at least three (3) expansion slots free for future expansion.

4.2.2 DATA DISPLAY

A high-resolution color flat panel display provides the test operator with relevant displays for conducting test operations. Menus presented on the Data Display permit the operator to configure the system as required before a test run.

The following apply:

- (a) 15" (diagonally measured) active matrix color display
- (b) Power – 110 VAC

4.2.3 KEYBOARD

The system has a detached, IBM-PC at miniature microcomputer style keyboard with track-pad for operator control of the system. The keyboard is used by the test operator to configure the system for test activities and to edit the data as required. A subset of the Event Board keys is also implemented so that keyboard can be used for test activities.

4.2.4 DATA ACQUISITION SUBSYSTEM (DAS)

All real-time verification activities are coordinated by the Data Acquisition Subsystem (DAS) contained in the trailer. The DAS provides the interface between the processing unit and all other functions (including those on the trailer) controlled by the computer system. Signals are cabled to conditioning modules located in the test trailer and control panel then are then are passed to the computer I/O modules. The computer system derives distance, speed, traction, and load from transducers (including strain gage bridges) mounted in the trailer; activates the trailer water and brakes; interfaces to the control panel i.e. read switches, output to indicators; derives distance and location information from the transmission distance transducer, process operator inputs from the Event Keyboard and control panel signaling that the test vehicle has encountered a significant feature; and passes information on the feature and its location to the processing unit for display and logging.

The following are provided by the DAS subsystem:

- (a) Interface and control routines in Main Program

(b) IBM-PC compatible plug-in module(s) with

- 1) 12 Bit 8 Channel A/D Converter
- 2) DMA interface with host
- 3) 5 Counter-Timers for A/D Conversion and event timing
- 4) 8 Digital I&O for Control Panel Interface
- 5) One Event Board interface
- 6) One Distance Pulse Generator Interface

(c) Analog Conditioning Interface with channels for

- 1) Traction inputs
- 2) Two Load Inputs
- 3) Two Tachometer Speed Input
- 4) One internal event state signal for Test Verification

(d) Measured distance accurate to 0.1% per mile for transport vehicle speeds up to 65 MPH

(e) Output to control brakes, water, and signal selection

(f) System power control

(g) Power: +5VDC, +12VDC, -12VDC supplied by Processing Unit

The transmission distance transducer provides the computer system with a pulse for each unit of distance traveled by the vehicle on the roadway. The computer system processes these pulses to arrive at a meaningful indication of distance traveled and vehicle speed. The computer system also receives signals from the friction trailer tachometers(s) for wheel speed. These are checked against vehicle speed calculated from the vehicle distance pulses in calibration and checkout. The system processes the signals and records the data from the unit(s) selected by the operator.

4.2.5 PRINTER

An ink-jet printer is used to produce hardcopy of various data during test operations.

The printer provides the following minimum requirements:

- (a) HP Laser or Ink Jet Printer
- (b) IBM-PC compatible Centronics parallel interface
- (c) IBM-PC compatible dot-addressable graphics
- (d) Power: 110VAC

4.2.5.1 EVENT BOARDS

The Event Board can be the primary user interface for test control and roadway feature entry as the vehicle travels along the roadway. Specific Event Board keys can be associated with each of the possible eventing modes and monitored by the DAS. Operator actuation of a key signals the DAS that the test vehicle has encountered a roadway feature or a test event takes place which requires actions appropriate to the type of function associated with the key. A 56 key two-hand event board or a smaller one-hand event board can be provided for operator(s) use.

4.2.5.2 TWO HAND 56 KEY EVENT BOARD

The following apply:

- (a) 56-key membrane keyboard
- (b) Key-pressed audible feedback
- (c) Power: +5VDC supplied by DAS

4.2.5.3 ONE HAND EVENT BOARD

The operator can be provided a one-hand data entry device. All lettering on the unit is large enough to be read by the operator at a glance.

After the operator has entered pertinent information prior to the testing of a roadway, the event board can be used to perform the functions listed below:

Initiate Testing

- 1) Initiate test
- 2) Abort or stop test
- 3) Start distance measurements
- 4) Stop distance measurements
- 5) Reset to start milepost (and set up distance increment)
- 6) Reset to end milepost (and set up distance decrement)

Mark Physical Roadway Features:

- 7) Identify milepost location of pavement change
- 8) Identify milepost location of bridge start
- 9) Identify milepost location of bridge end
- 10) Identify milepost location of intersection
- 11) Landmark a point for reference to a physical feature

Additionally, the unit is capable of expansion to support at least four (4) unspecified functions. These functions and/or similar functions can be provided as requirements change.

The following apply:

- (a) 16-key keyboard that fits in one hand
- (b) Key-pressed audible feedback
- (d) Power: +5VDC supplied by DAS

The system is designed so that the operation of the friction test vehicle can be performed by one individual using system control panel switches provided to initiate the test cycle and kill the test cycle. The operator is responsible for maintaining the test speed, observing accumulated data, distance, physical locations, and input as required during testing. Friction tests are conducted in urban and rural areas, under adverse driving conditions in some cases, usually at 40 miles per hour. Tests and kills may also be initiated from the computer keyboard and event board for ease of operation. A two-person operation is also provided where the second person can use both the keyboard and two hand event board.

All data is displayed to the operator on the CRT screen for data input, calibration, and monitoring vertical and horizontal transducer output signals. Gain and zeroing adjustments that are necessary for load and friction number calibration are automatically adjusted by the system when possible at calibration. Added adjustment controls are provided on the console panel for use prior to auto adjustment.

5.0 SYSTEM FUNCTIONAL SOFTWARE MODULES

The computer system contains all the necessary software modules to allow an operator to perform all tasks necessary to perform friction testing with or without a RFF file. The software can operate within the normal Windows XP operating system and can remain in control until the system is shut down by the operator. The system provides software to perform automatic execution, perform program initialization, allow operator selection of the required system operations and perform all of the required system operation functions to provide the operation of the friction testing.

5.1 PROGRAM INITIALIZATION

The software provides a central program initialization function, which is loaded by Windows. The program initialization performs start-up initialization, initialize program control parameters, and activate a start-up self test, which requires no operator input. If the start-up self test has indicated a NO-GO, the result of the test is displayed to the operator with a message to take some action. If the results of the start-up self test are GO, the operation selection function is activated with the Main Menu automatically selected.

5.2 OPERATION SELECTION

The operation selection function displays a main menu of system operations functions, which can be performed when selected by the operator. The main menu selection instructions are displayed

to the operator along with the main menu choices. The selection is provided via the computer keyboard and/or on the 56 key event board. Less than eight functions are displayed.

5.3 SYSTEM OPERATION FUNCTIONS

The system provides operation functions selected by the operator main menu. The system operation functions provide everything necessary for the operator to perform friction testing in a user friendly manner. The system operations include functions to (1) save parameters to disk and perform system shutdown, (2) perform a system self test, (3) perform all file manipulations required for operations, (4) allow ID's (such as driver, operator, and vehicle) and parameters to be saved and changed, (5) perform friction test control setup (6) provide operator activated distance calibration, bridge calibration, water flow calibration, (7) provide a friction test operation mode, save and display test results, (8) show the test status and (9) provide a distance movement simulation which exercise the functional systems.

5.3.1 SHUTDOWN

The system operation software provides a system shutdown which is operator activated via the keyboard. Prior to returning to Windows, the system saves all active parameter data so it may be restored when the program is restarted.

5.3.2 SELF-TEST

The system operational software provides a self test function which tests 65% of the system without operator action, and 90% of the system with operator action and decisions. Self test is usable with or without the movement simulation function. Self test guides the operator through all required input via the monitor selections. The test mode can provide verification for operation of the computer, the monitor, the keyboard, the DAS, the event board, the printer, and distance sensor.

5.3.3 FILE OPERATIONS

The operational system software provides all file operations necessary to perform all aspects of selecting a RFF file, saving test results, and creating a TRF. This includes creating and copying out RFF files, TRF files, log files, and parameter files without the operator using direct commands. All instructions for operator action and all file operation results are displayed on the monitor to the operator. The READ after WRITE verify is used for all disk write operations.

5.3.4 CHANGE ID'S AND PARAMETERS

The system maintain parameters in the program file which can be used to save calibration data, ID's for the vehicle, driver and operator, date and time used, test location data, etc., and information about the files on disk. The system displays the ID's to the operator by operator selection and saves new entries in the program file.

The system contains provisions to accept up over 20 variables similar to those listed below from the operator prior to the beginning of testing of a roadway section. The software insures that the operator enters all required variables. Numeric variables default to ascii zeros. Alpha variables default to blanks. The variable data is saved in the TRF files along with the test data for further post processing.

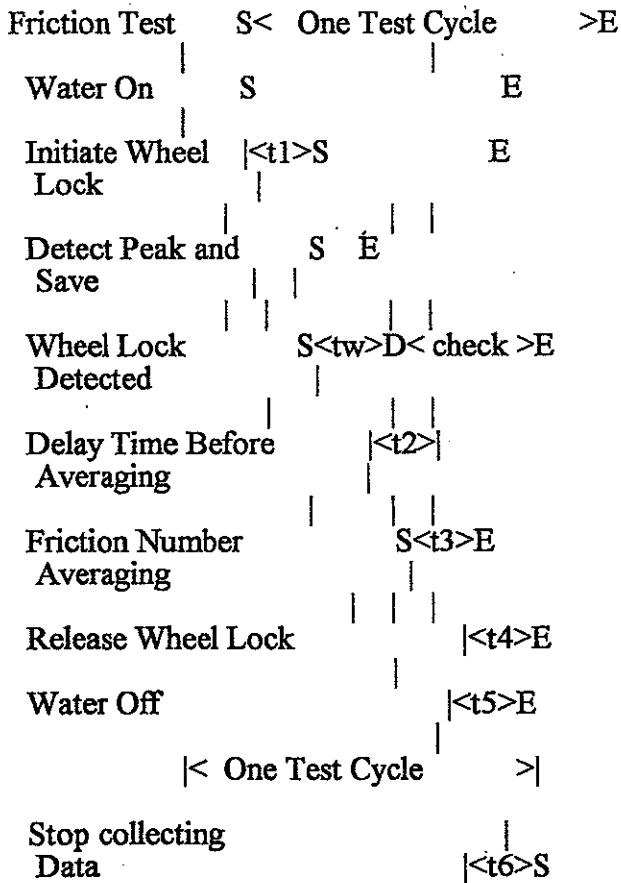
Abbreviations: A = alphabetic N = numeric

| <u>VARIABLE</u> | <u>LENGTH</u> | <u>TYPE</u> | <u>EXAMPLE</u> |
|--------------------------|---------------|-------------|----------------|
| 1) Calendar Date | 8 | A/N | 02/12/86 |
| 2) Job Number | 4 | N | 3433 |
| 3) State Road Number | 5 | A/N | 26A |
| 4) District | 1 | N | 1 |
| 5) County Section Number | 5 | N | 26260 |
| 6) Sub Section Number | 4 | N | 3433 |
| 7) Beginning Milepost | 6 | A/N | 99.999 |
| 8) Lane Tested | 10 | A | Traf |
| 9) Milepost Count Up/Dn | 1 | A | U=up d=down |
| 10) Number of Lanes | 2 | N | 04 |
| 11) Day/Night | 5 | A | Night |
| 12) Weather | 6 | A | Cloudy |
| 13) Air temperature | 3 | N | 95 |
| 14) Unit Number | 2 | N | 01 |
| 15) Operators Initials | 3 | A/N | AMS |
| 16) Request Type | 1 | N | 5 |
| 17) Surface | 2 | N | 26 |
| 18) Direction | 5 | A | North |
| 19) Data File Name | (as required) | | |
| 20) Calibration Factors | (as required) | | |

5.3.5 FRICTION TESTS CONTROL SET UP

The friction test control set up function receives, displays, stores, and records basic information to control the automatic friction test cycle entered by the operator. The test cycle is performed as given in the Friction Test Timing Diagram, Figure 5-2. The values are entered by the operator in a test set up mode when chosen by the operator. The parameters are stored on a hard disk and loaded each time the test system is activated. The operator is able to (1) set the amount of time the water is on before the trailer brake is applied to lock the wheel (t1), (2) set the amount of time after the wheel is locked until data averaging starts (t2), (3) set the amount of time data averaging is performed (t3), (4) set the amount of time after data averaging stops until the brake is unlocked (t4), (5) set the amount of time after the brake is unlocked until the water is turned off (t5) and (6) set the amount of time after the water is turned off until the test data is stopped being collected (t6). The operator is able to set a time (tw) to determine the wheel lock is not occurring and cause a warning. The operator is also able to select a dry test without water being used with the rest of the cycle being the same. Values that meet the requirements of ASTM 274-90 are used as initial values in the program prior to the operator making any changes in the timing. The operator may review and modify the values if desired.

Figure 5-2
FRICITION TEST TIMING DIAGRAM



Note: A second test cycle can be initiated after t6 if the successive test is being requested by the operator.

S - Start of Event E - End of Event

D - Wheel Lock Detected

< check > - System Verifies Wheel is Locked

5.3.6 CALIBRATION

The operational system software allows the operator to perform a distance sensor calibration and use the calculated factor to perform the operational distance measurements and speed calculations. The calibration software also allows the operator to save the factor calculated or change the calibration factor to other than the calculated value. The software also enters the calibration value into the program file from which it can be used to make file header entries. The operator only needs to enter the distance traveled in feet, kilometers, or miles and not make any calculations to determine the calibration factor.

5.3.7 FRICTION TESTING

The operational system software provides all necessary functions for the operator to select and perform friction testing for a specific route in a county. The software determines both an average friction value during the time interval shown plus determines the peak friction value during the test cycle. The software also detects abnormal conditions in the test result data and reports the condition to the operator. The friction testing software saves the test result data and measured cartographic features in memory during friction testing and outputs them to disk after the data has been saved by operator action.

The friction test software activates the friction test cycle using the timing and control parameters stored by the friction test control set up software. The software monitors the signal to verify that the test was performed properly with the wheel locked, the average change normal and water flow normal. Abnormal test cycle data is stored for later operator review on the CRT.

The friction test software can receive, display, store and print load, traction (and water flow signals where available) received from transducers.

The friction test software can receive, display, store and print with each friction test corresponding distance (milepost) and test speed. Free wheeling tachometers are located on each trailer axle to measure speed. A pulse generator is associated with vehicle transmission to measure distance. The unit can select one of the tachometers for the test speed under operator control. The system obtains the test speed from the wheel not being locked. The selected sensor is displayed to the operator and its ID recorded with the test data.

The friction test software can receive, display, store and print pertinent and physical data relating to test site (key entry) observed during testing of a roadway, e.g., posted speed limit changes, surface changes, bridges, etc. The corresponding milepost is stored at the time of key entry.

The system is capable of calculating, displaying, and storing the peak and average friction value obtained from the received signals recorded (load and traction). Additionally, the system is capable of putting the accumulated friction test results through mathematical equations and printing results when enabled by the operator. For example, accumulated data would be placed

through a statistical analysis to determine N count, mean value (X), standard deviation (S), high friction value and low friction value.

The display of vehicle speed and current milepost data is very important to the operator. As stated earlier, the speed is displayed continuously on the dash mounted digital voltmeter during testing.

The current milepost is displayed constantly on the CRT during testing also. After the friction test cycle is completed and the friction number is computed, the milepost location of the brake lockup is displayed.

After the friction test cycle is complete, the operator is able to read the milepost location, average test speed during lockup, friction number and test validity.

The production of the friction number is the purpose of the friction test. The formula used for the calculation of the friction number is:

$$FN = F/W \times 100$$

where:

f = traction force, (horizontal force applied to the test tire at the tire-pavement contact patch), in pounds per foot (lbf)

w = the dynamic vertical load on the test wheel, pounds per foot (lbf).

After the test results are recorded, upon command, accumulated data can be processed through a mathematical equation to determine the following by section and/or route.

| | |
|---------------------|---|
| Number of Tests | N |
| Mean FN | X |
| Standard Deviation | S |
| High Friction Value | H |
| Low Friction Value | L |

Note: The operator can command this or override the process depending on the situation.

When enabled by the operator, all recorded test results can be reported so that the data recorded on media can be verified.

5.3.8 SIMULATOR ON/OFF

The operational system software utilizes a distance pulse simulator feature. The software can provide for the simulator to be turned OFF or ON by operator selection. The status of the simulator is kept in memory. The simulator ON allows the other operational system software to perform normally but does not allow records to be saved in the TRF FILE. The simulation ON indicates the "ON" status to the operator when "ON". The simulator software provides the means to specify the simulation speed up to 65 MPH.

6.0 MOUNTING AND INSTALLATION OF EQUIPMENT

Installation of the equipment includes a mounting arrangement that can be easily used by the driver and operator.

Careful consideration has been given to the mounting and location of equipment. Mounting of equipment has been made in a manner to withstand normal vibrations that occur while traveling at speeds of 0-65 MPH. The location of equipment is accessible to the operator but does not impede safety.

Electronic components are restrained where possible with tie downs or other applicable methods.

6.1 POWER REQUIREMENTS

The power supply used for the microcomputer peripheral devices and remaining test equipment are independent of the electrical system used for normal vehicle functions.

6.2 MANUALS

Upon delivery of the system, the following are typically provided:

- (1) Two copies of operating procedures for all operational software.
- (2) One copy of schematics, block diagrams and wiring diagrams covering electronic circuitry of the new system.
- (3) One copy of parts lists listing the components of all equipment used.

6.3 OPERATOR TRAINING

6.4 ASTM E274

The system is capable of receiving and storing data obtained when conducting skid tests to measure the friction characteristics of paved surfaces using a full-scale tire in accordance with ASTM E274.

6.5 WARRANTIES

The system including any modifications to existing equipment required to produce the system, for a period of not less than 12 months from date of delivery to be free from defects in material and workmanship. This will include any latent software defects detected before and after acceptance of the equipment. Vehicle warranties are passed on to the procuring agency as per the vehicle manufacturer.

7.0 DELIVERY TIME AND PLACE

The delivery time for this vehicle is 180 days from the date it is received by the vender. Delivery address is WVDOT, 190 Dry Branch Road, Charleston, West Virginia 25306.

AGREEMENT ADDENDUM

In the event of conflict between this addendum and the agreement, this addendum shall control:

1. **ARBITRATION** - Any references to arbitration contained in the agreement are hereby deleted. Disputes arising out of the agreement shall be presented to the West Virginia Court of Claims.
2. **HOLD HARMLESS** - Any clause requiring the Agency to indemnify or hold harmless any party is hereby deleted in its entirety.
3. **GOVERNING LAW** - The agreement shall be governed by the laws of the State of West Virginia. This provision replaces any references to any other State's governing law.
4. **TAXES** - Provisions in the agreement requiring the Agency to pay taxes are deleted. As a State entity, the Agency is exempt from Federal, State, and local taxes and will not pay taxes for any Vendor including individuals, nor will the Agency file any tax returns or reports on behalf of Vendor or any other party.
5. **PAYMENT** - Any references to prepayment are deleted. Payment will be in arrears.
6. **INTEREST** - Should the agreement include a provision for interest on late payments, the Agency agrees to pay the maximum legal rate under West Virginia law. All other references to interest or late charges are deleted.
7. **RECOUPMENT** - Any language in the agreement waiving the Agency's right to set-off, counterclaim, recoupment, or other defense is hereby deleted.
8. **FISCAL YEAR FUNDING** - Service performed under the agreement may be continued in succeeding fiscal years for the term of the agreement, contingent upon funds being appropriated by the Legislature or otherwise being available for this service. In the event funds are not appropriated or otherwise available for this service, the agreement shall terminate without penalty on June 30. After that date, the agreement becomes of no effect and is null and void. However, the Agency agrees to use its best efforts to have the amounts contemplated under the agreement included in its budget. Non-appropriation or non-funding shall not be considered an event of default.
9. **STATUTE OF LIMITATION** - Any clauses limiting the time in which the Agency may bring suit against the Vendor, lessor, individual, or any other party are deleted.
10. **SIMILAR SERVICES** - Any provisions limiting the Agency's right to obtain similar services or equipment in the event of default or non-funding during the term of the agreement are hereby deleted.
11. **ATTORNEY FEES** - The Agency recognizes an obligation to pay attorney's fees or costs only when assessed by a court of competent jurisdiction. Any other provision is invalid and considered null and void.
12. **ASSIGNMENT** - Notwithstanding any clause to the contrary, the Agency reserves the right to assign the agreement to another State of West Virginia agency, board or commission upon thirty (30) days written notice to the Vendor and Vendor shall obtain the written consent of Agency prior to assigning the agreement.
13. **LIMITATION OF LIABILITY** - The Agency, as a State entity, cannot agree to assume the potential liability of a Vendor. Accordingly, any provision limiting the Vendor's liability for direct damages or limiting the Vendor's liability under a warranty to a certain dollar amount or to the amount of the agreement is hereby deleted. In addition, any limitation is null and void to the extent that it precludes any action for injury to persons or for damages to personal property.
14. **RIGHT TO TERMINATE** - Agency shall have the right to terminate the agreement upon thirty (30) days written notice to Vendor.
15. **TERMINATION CHARGES** - Any provision requiring the Agency to pay a fixed amount or liquidated damages upon termination of the agreement is hereby deleted. The Agency may only agree to reimburse a Vendor for actual costs incurred or losses sustained during the current fiscal year due to wrongful termination by the Agency prior to the end of any current agreement term.
16. **RENEWAL** - Any reference to automatic renewal is hereby deleted. The agreement may be renewed only upon mutual written agreement of the parties.
17. **INSURANCE** - Any provision requiring the Agency to insure equipment or property of any kind and name the Vendor as beneficiary or as an additional insured is hereby deleted.
18. **RIGHT TO NOTICE** - Any provision for repossession of equipment without notice is hereby deleted. However, the Agency does recognize a right of repossession with notice.
19. **ACCELERATION** - Any reference to acceleration of payments in the event of default or non-funding is hereby deleted.
20. **AMENDMENTS** - All amendments, modifications, alterations or changes to the agreement shall be in writing and signed by both parties. No amendment, modification, alteration or change may be made to this addendum without the express written approval of the Purchasing Division and the Attorney General.

ACCEPTED BY:
STATE OF WEST VIRGINIA

VENDOR

Spending Unit: _____

Company Name: _____

Signed: _____

Signed: _____

Title: _____

Title: _____

Date: _____

Date: _____

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

West Virginia Code §5A-3-10a states: No contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and the debt owned is an amount greater than one thousand dollars in the aggregate

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Debtor" means any individual, corporation, partnership, association, limited liability company or any other form or business association owing a debt to the state or any of its political subdivisions. "Political subdivision" means any county commission; municipality; county board of education; any instrumentality established by a county or municipality; any separate corporation or instrumentality established by one or more counties or municipalities, as permitted by law; or any public body charged by law with the performance of a government function or whose jurisdiction is coextensive with one or more counties or municipalities. "Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

EXCEPTION: The prohibition of this section does not apply where a vendor has contested any tax administered pursuant to chapter eleven of this code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

LICENSING: Vendors must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agencies or political subdivision. Furthermore, the vendor must provide all necessary releases to obtain information to enable the Director or spending unit to verify that the vendor is licensed and in good standing with the above entities.

CONFIDENTIALITY: The vendor agrees that he or she will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the agency's policies, procedures and rules. Vendors should visit www.state.wv.us/admin/purchase/privacy for the Notice of Agency Confidentiality Policies.

Under penalty of law for false swearing (West Virginia Code, §61-5-3), it is hereby certified that the vendor acknowledges the information in this said affidavit and are in compliance with the requirements as stated.

Vendor's Name: _____

Authorized Signature: _____ Date: _____