

PROJECT: _____

WEIGH-IN-MOTION SCALE SYSTEM

1.0 DESCRIPTION

This Work consists of furnishing and installing, in accordance with the Plans and these Specifications, a Weigh-In-Motion System which shall automatically select those vehicles for legal static weighing and over height which exceed: (1) a manually entered threshold for axle or gross weight; (2) weight and axle spacing limitations as set forth in the Bridge Formula as described in Section 3.0 and (3) is within six inches of, or above, the maximum height limitation as set forth herein.

This Work includes, but is not limited to the following package components including all accessories, constructed as shown on the Plans and as described herein:

- a. Quartz Weighing Sensors
- b. Loop Type Presence Detector
- c. Over-height Detector
- d. Control Unit with Processor and Transmitting Elements
- e. Traffic Control Subsystem

The Weigh-In-Motion (WIM) scale system shall be integrated into the Truck Weigh Station Control System (TWSCS) which contains subsystems and components that interact together to complete the total weight presort system (WPS). The WIM's function is to automatically sort and direct vehicles into one of two categories; potential violators and non-violators. Sort criteria includes the following adjustable parameters:

- a. Gross vehicle weight
- b. Axle weight
- c. Axle spacing
- d. Vehicle speed
- e. Change in vehicle speed
- f. Off-scale
- g. Over-height
- h. Random selection

The operator may manually override the system and direct all vehicles to the static scale by pressing the appropriate pushbutton or key.

The WIM scale includes the following major components:

- a. Two sets of quartz sensors (may be four sets for redundancy)
- b. Off-scale sensors

- c. Vehicle loop Detector
- d. Over-height Detector
- e. Instrumentation Enclosure including WIM Controller
- f. Signalization
- g. Operator's Manual Control Console
- h. Weigh Station Computer and Report Printer

2.0 MATERIALS

All materials and associated equipment shall conform to the Plans and the Specifications contained herein. When material or equipment is designated in the Plans or in the Specifications by *Brand Name or Equal* the material or equipment offered as equal may be substituted in the Work provided the Contractor has submitted in writing to the Engineer, for approval, the name and complete description, including supporting data, of the specific material or equipment offered. The Engineer will notify the Contractor if said material or equipment is approved as equal or disapproved.

3.0 PERFORMANCE

The WIM Scale shall automatically and accurately weigh, within the tolerances set forth herein, each axle of a multi-axle vehicle and calculate the gross weight of the vehicle by summing the individual axle weights. Each vehicle having a gross weight of 39,000 pounds or more shall be checked for compliance with the Bridge Formula as defined by the Federal Highway Administration. The WIM Scale shall perform these measurements and calculations while the vehicle passes over the WIM Scale but not to exceed 5 seconds.

The gross and individual axle weights of each vehicle shall be accurately established to within the error limits listed in Table 1. These error limits shall be maintained within a confidence level of two standard deviation (96%) for a minimum sample of 100 vehicles. The sample shall consist of a variety of multiple-axle trucks passing over the scale at speeds ranging from a minimum of 10 mph to a maximum of 50 mph with at least half at 30 mph or greater. Tank trucks, livestock, car haulers and those vehicles whose suspension characteristics are determined to affect the scale performance shall not be included in the sample nor shall trucks whose speed varies by 10% or more.

| PARAMETER | TOLERANCE |
|-------------------------------|------------------------|
| Single Axle Weight | ± 15% of actual weight |
| Axle Group (2 or more) Weight | ± 10% of actual weight |
| Gross Weight | ± 6% of actual weight |
| Axle Spacing | ± 6 inches |
| Vehicle Speed | ± 2 mph |

Table 1. WIM Scale Accuracy

The actual weight is defined as that vehicle weight established by static weighing on a multi-platform truck scale properly operating within the appropriate tolerance as established for a Class III device as defined in National Institute of Standards and Technology Handbook 44. The WIM Scale shall operate over a ambient temperature range of -40 to +57 degrees C with 10 to 100% humidity.

WIM Scale functions shall include the following:

- a. Operate at vehicle speeds between 10 and 50 mph
- b. Determine the legality of each vehicle based on axle, axle group and gross vehicle weights.
- c. Determine the legality of each vehicle based on vehicle speed and maximum height.
- d. Determine the compliance of each truck in excess of 39,000 pounds gross weight with the Bridge Formula
- e. Determine whether the vehicle is to be sent to the static scale based on gross and axle weights, speed, actuation of off-scale sensors and/or over height and turn on the appropriate traffic lane signal
- f. Print various summary reports by truck classification broken down by shift, day, month and calendar year.
- g. Store in non-volatile memory the data necessary for the summary reports
- h. Integrate with the Truck Weigh Station Control System as required.

4.0 WEIGH-IN-MOTION SCALE

The WIM Scale shall consist of two sets of quartz sensors in the single traffic lane. Each sensor set shall be a minimum of 1.5 m in length and shall be positioned such that each sensor set weighs one side of the vehicle thus obtaining weight information sufficient to determine any side-to-side balance condition of the vehicle. The sensor's shall be of the Kistler Type 9195 or equivalent. Sensors shall have a minimum capacity of 5 N per square mm and a minimum resonant frequency of 5 kilohertz. Sensors shall be mounted precisely flush with the surface of the pavement and shall extend no deeper than 70 mm into the pavement. Sensors and associated coaxial cable shall be sealed to prevent moisture penetration. Sensors shall not be damaged by road maintenance such as sweeping and snow removal. Sensors shall be warranted for a minimum of two years against defects in material or workmanship.

The WIM Scale shall include off-scale detection to sense any vehicle off the weighing surface of the quartz sensors. Off-scale sensors shall be placed in such a manner that a vehicle moving to either side of the quartz sensors will be detected. Off-scale sensors shall use piezoelectric technology and shall be mounted flush with the road surface.

The vehicle detector loop shall consist of a minimum of two turns of 12 AWG wire and placed in a cut a 20 to 25 mm deep in the pavement. The vehicle loop wire shall be connected to the electronics cabinet with a twisted pair of wires containing a minimum of one complete twist for approximately every 25 mm of length.

The instrumentation for the WIM scale shall include the following:

- a. Dual-channel charge amplifier
- b. High-speed A/D converter
- c. Industrial computer
- d. UPS (Uninterruptable Power Supply)
- e. Thermostatically-controlled heater
- f. Thermostatically-controlled ventilation fan
- g. Loop detector amplifier

These components along with the necessary interface circuitry shall be housed in a single traffic cabinet constructed of non-corrosive material and mounted on a concrete pedestal adjacent to the WIM Scale sensors. The cabinet shall be equipped with a locking door using standard traffic enclosure components. The cabinet shall contain a thermostatically controlled heater and separately controlled ventilation fan to maintain a relatively constant temperature within the cabinet. The cabinet shall include a convenience power outlet with GFIC circuit protector and shall be grounded in accordance with the manufacturer's instructions. The dual-channel charge amplifiers shall be connected to the quartz sensors via coaxial cables with quick disconnect connectors. Cables between the cabinet and quartz sensors, loop detector, over-height detector, traffic control signals, remote computing peripheral and power source shall be contained within conduit as specified by the manufacturer. The internal computer shall be of the industrial type and shall contain dual high-speed A/D converters for conversion of the quartz sensor weight signals. The computer shall contain a minimum of a Pentium processor, 1 Mb of RAM and sufficient memory for execution of the application software program. It shall contain sufficient I/O for control of the traffic lane signal lights, accept the inputs from the over-height detector, off-scale sensors and loop detector amplifier output. The computer shall contain the software program necessary to perform all functions contained herein except for the storage of historical vehicle data, display of WIM weights and preparation and printing of summary reports. The computer shall transmit WIM Scale information to the Weigh Station Office Computer via a fiber optic cable using the manufacturer's standard protocol or another appropriate and documented protocol. The cabinet shall also contain an uninterruptible power supply capable of powering the WIM Scale and associated circuitry including the traffic lane signal lights for a minimum of 5 minutes after loss of utility power. Switching from utility power to the uninterruptible power supply shall be automatic and without disruption of system operation.

5.0 OVER-HEIGHT DETECTOR

This specification for the over-height detection of over-height vehicles entering the truck weigh station. The detection of over-height vehicles shall take place along with the in-motion weight measurement. The over-height detector shall consist of a single-eye infrared model meeting the following specifications:

- a. Input Power: 115 VAC \pm 10% 60 Hz
- b. Output: Form C, dry relay contact closure rated at 115 VAC 10A and protected by an appropriate circuit breaker
- c. Temperature Range: The over-height detector shall operate over an ambient temperature range of -40 to $+57$ degrees C
- d. Rain: The detector shall operate properly during a rain fall of 20mm/h and shall withstand rain falls of up to 100 mm/h.
- e. Dust: The detector shall withstand and be capable of operating when subjected to sand and dust particles up to 1 g per cubic meter with particles ranging from 10 to 100 micrometers in diameter.
- f. Reaction Speed: Able to detect a 50 mm diameter object 25 mm above the detection height traveling at a speed of 75 mph.
- g. Alarm Time: Adjustable from 1 to 30 seconds
- h. Maximum Range: 200 m
- i. Housing: NEMA 6P rated enclosure

6.0 INSTRUMENTATION; WEIGH STATION OFFICE COMPUTER

The Weigh Station Office Computer shall be located within the weigh station office building and shall receive WIM Scale data from the WIM Scale via fiber optic cable. The fiber optic cable shall be a minimum of multi-mode glass cored cable and shall be contained in conduit buried between the weigh station office building and the WIM Scale site. As an alternative, armored direct burial fiber optic cable may be used. The Weigh Station Office Computer will be used in an environmentally-controlled office building designed for reasonable human comfort. The Weigh Station Office Computer shall be operated from a 115 \pm 10% VAC 60 \pm 2 Hz single phase electrical service and require no more than 10A of current. Said computer shall consist of a minimum of a Pentium 4 processor, 40 Gb HDD, 128 Mb RAM, 56K modem with 3.5 inch FDD and CDROM drive. It shall include a minimum of a 17-inch color video display, operator keyboard and mouse and shall include a minimum of a Windows-98 [®] operating system. Sufficient I/O shall be included to allow the computer to monitor the traffic loop detectors in the bypass and static lane and at the static scale exit, accept data from the WIM Scale computer and drive the report printer. The computer shall be of modular design and contain sufficient non-volatile memory to retain weight records from the WIM Scale in the event of a power outage. An uninterruptible power supply shall be included and of sufficient capacity to operate the computer and associated peripherals for a minimum of 5 minutes in case of a power outage.

The Weigh Station Office Computer shall display the axle weights, gross weight, speed, axle spacing and classification on a single display line for each vehicle crossing the WIM Scale. The data entry for those vehicles directed to the static scale shall appear in a red color to indicate their status to the operator.

A laser printer shall be included with the Weigh Station Office Computer to print operator selected and initiated summary reports. The printer shall have the following features:

- a. Technology: Laser
- b. Print speed: 6ppm, minimum
- c. Printing characteristics: non-impact, electro-photographic, full page
- d. Resolution: 300 dpi horizontal and vertical, minimum
- e. Type attributes: Italics, oblique, bold and combinations
- f. Font selection: 17 type 1 scalable fonts and 10 bitmapped fonts
- g. Character set: ATM resident, full IBM PC resident character set
- h. Maximum print line: 200 mm portrait, 340 mm landscape

7.0 INSTRUMENTATION, TRAFFIC CONTROL SYSTEM

Two Light-Emitting Diode (LED) Lane-Control Signals shall be furnished and installed overhead on a mast arm. Each signal shall have the capability of displaying both a red "X" and a green "↓". The Lane-Control Signals shall be driven from the WIM Scale computer and shall have the following characteristics:

- a. When not illuminated, the signal message shall not be visible regardless of ambient lighting levels.
- b. The signal message shall be clear and legible under any lighting conditions at a distance of 1300 feet.
- c. The signals shall be rated for use in ambient temperature ranges of -40 to + 74 degrees C.
- d. The LED display module shall be completely sealed against dust and moisture intrusion per the requirements for NEMA type 4 enclosures.
- e. The messages shall have a minimum height of 450 mm.
- f. The individual LED light sources shall be so interconnected that a catastrophic failure of a single LED will not result in a total loss of more than 5 LEDs.
- g. The face lens shall be constructed of non-glare matte-finish polycarbonate with UV-resistant surface treatment.
- h. The LED drive modules shall be designed to dim automatically based on the ambient light level and shall incorporate a 30 second delay to prevent interference caused by shadows or headlights.
- i. A minimum of 150 mm deep sun visor shall be provided.
- j. The signals shall be UL approved for outdoor service.

A manual console shall be located in the Weigh Station Office and shall be capable of manually controlling the traffic lane signal lights, the stop light at the static scale and the OPEN-CLOSED sign for the Weigh Station. The manual console shall include a single AUTO-MANUAL switch to change control of the traffic lights from the computer control system to the manual console. A single switch shall be provided for the traffic lane signal lights and will control the lights such that all traffic is directed either to the static lane or to the bypass lane. Single switches shall also be provided for the static scale traffic light and for the OPEN-CLOSED sign. Indicator lights shall be provided for each switch to show the current status of the signal light.

8.0 SUPPLIER REQUIREMENTS

The WIM Scale shall have been installed for at least 4 years within North America and the vendor shall provide at least 4 references for similar weigh station applications. The vendor shall provide a minimum of a 1-year warranty in writing against defective material and workmanship warranting that the equipment will give proper and continuous operation as described herein or which may be reasonably inferred for a period of 12 months from the date of the beginning of the Acceptance Performance Test. The warranty shall cover materials, equipment, service, labor, travel and all incidentals necessary for warranty service and shall warrant that the equipment is new and unused. The warranty excludes damage caused by fire, flooding, accidents, vandalism or natural disasters. Lightning damage, with exception of that caused by a direct strike, shall be included in the warranty. Warranty service shall be provided within a maximum of 48 hours, excluding weekends. This time shall begin upon notification of the vendor.

9.0 ACCEPTANCE PERFORMANCE TEST

Calibration of the WIM Scale shall be performed by the Contractor after installation is completed and prior to it being integrated with the static scale. Calibration vehicles and / or calibration weights shall be provided by the Contractor.

The Acceptance Performance Test period shall begin on the first normal working day following the completion of the scale calibration and testing. The Contractor shall submit a test plan to the Engineer for approval within 30 days after Notice to Proceed. During the test period, the WIM Scale sorting system shall be operated for approximately 8 hours per day for 5 days for 4 weeks. Performance will be checked by comparing WIM Scale weights with actual vehicle weight samples from the static scale. Tanker trucks, car and livestock haulers and trucks with suspension defects (out of round wheel, etc.) shall not be included in the sample.

The Acceptance Performance Test shall demonstrate to the satisfaction of the Department that the WIM Scale consistently meets the performance requirements of the Plans and of these Specifications and will serve as the basis for acceptance or rejection of the WIM Scale as a result of demonstrated performance.

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