097.13 DPWH
12-11-2017

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

11 DEC 2017

DEPARTMENT ORDER) **SUBJECT : DPWH Standard Specifications for Item 627 - WEIGH-IN-MOTION (WIM) SYSTEMS AND AUTOMATIC TRAFFIC COUNTER/CLASSIFIER (ATC) EQUIPMENT**
)
No. 140)
Series of 2017 12.11.17)

In order to ensure uniformity in the application/adoption of the Pay Items of Work, and in line with the mandate of the Department to provide Standard Specifications in the implementation of various infrastructure projects, the attached **DPWH Standard Specifications on Item 627 - WEIGH-IN-MOTION (WIM) SYSTEMS AND AUTOMATIC TRAFFIC COUNTER/CLASSIFIER (ATC) EQUIPMENT** is hereby prescribed, for the guidance and compliance of all concerned.

This Standard Specification will form part of the DPWH Standard Specifications for Highways, Bridges and Airports, Volume II.

This Order shall take effect immediately.

MARK A. VILLAR
Secretary

14.1.2 FET/RGT

DPWH Standard Specifications for Item 627 - WEIGH-IN-MOTION (WIM) SYSTEMS AND AUTOMATIC TRAFFIC COUNTER/CLASSIFIER (ATC) EQUIPMENT

627.1 Description

This Item shall consist of furnishing all materials, supplies, tools, equipment including all labor, orientation and training required for the Automatic Traffic Counter/Classifier (ATC) capable of counting and classifying vehicle types as it passes an in-ground or above-ground sensors and Weigh-In-Motion (WIM) capable of recording both the vehicle's axle load and gross vehicle weight installed perpendicular on and/or off the roadway in accordance with approved Plans and this Specifications, or as required by the Engineer.

627.2 Submittals

The Contractor shall submit all related documents which shall be subjected to the approval of the Engineer. The final documentation shall be submitted by the Contractor based on the Engineer's comments.

627.2.1 Product Data

The Contractor shall submit two (2) sets of User's and Operator's Manual and Installations Manuals, which includes but not limited to procedures, sequences, tolerances and precautions. One (1) copy shall be for the Engineer and one (1) for the end user. One (1) set of electronic copy shall also be submitted as a backup file. Submitted manuals must be up-to-date and reflect any changes which occurred during installation. Contents shall include, but not limited to, the following information:

1. Identification of items or components furnished on the job by tag number, model number and manufacturer.
2. Complete description, function, specifications, descriptive literature on the components and statement as to whether the item is "as specified" or "equivalent".
3. Manufacturer's original catalogue and technical data sheets for all components.
4. Parts list and spare parts to be provided/recommended.
5. Material, test and calibration certificates.
6. Recommended procedure for protection of equipment against damage, prior to installation.
7. Operational procedures and shut-down procedures.
8. Maintenance, calibration, and troubleshooting instructions.

627.2.2 Drawings

The Contractor shall submit a completed engineered drawings and shop drawings to the Engineer. Drawings shall include, but not limited to, the following:

1. Dimensions and layouts
2. Complete schematic and wiring and equipment installation diagram
3. Termination details

The Contractor shall submit record drawings of work as actually constructed, complete with schematics, wiring diagrams, installation drawings and other pertinent details as specified in this section.

627.3 Material Requirements

All materials and equipment shall be brand new and shall be an International Brand Name with existence of at least five (5) years in the Philippines, and shall comply with the requirements of relevant existing Philippine codes and standards.

627.3.1 ATC Data Logger/Machine

627.3.1.1 Purpose

The ATC machine shall measure and record the following data on a permanent or temporary basis:

1. Vehicle classification: The machine shall have in-built standard vehicle classification schemes, and optionally allow the user to create or modify the vehicle classification scheme based on local vehicles.

2. As a minimum, the ATC system shall classify vehicles based on the approved vehicle classification scheme stipulated in the DPWH Highway Planning Manual adopting twelve (12) vehicle types, namely, motor-tricycles, passenger cars, passenger utilities, goods utilities, small buses, large buses, rigid trucks (2 axles), rigid trucks (3+ axles), truck semi-trailer (3 and 4 axles), truck semi-trailer (5+ axles), truck trailers (4 axles), and truck trailers (5+ axles).

3. Traffic counts shall be recorded and stored by vehicle type, either in real-time/through post-processing.

4. Vehicle speeds shall be recorded for each vehicle class, optionally binned into user definable speed bins in real-time/through post-processing.

5. Vehicle occupancy shall be provided.

627.3.1.2 Functional Requirements

1. **Vehicle speed range:** The machine shall be capable of classifying vehicles within the speed range of 15 km/hr to 130 km/hr.

2. **Accuracy:** The machine shall be capable of detecting, recording, and classifying traffic data to within the accuracy tolerance of ±5 % or less.

3. **Number of lanes to be covered in an installation:** The machine shall be capable of detecting the type of motor vehicle including the direction of travel for carriageway with up to four (4) lanes maximum per direction.

4. **Indication of data:** The measured data shall be shown on the data processor or any appropriate device in real time for Quality Assurance.

5. **Print out of data:** The machine must be possible to print the measured data out on appropriate paper.

6. **Capacity for data storage:** The machine shall have sufficient internal memory to store collected traffic data carrying a minimum of 30,000 vehicles/day/lane with a minimum recording capacity of seven (7) days.

7. **Data retrieval:** The data shall be retrieved either through Manual (Direct or Wireless) or Remote Transmission, as may be specified.

   For Direct Manual Retrieval, downloading of data from the machine shall be achieved using a laptop or notebook computer, personal data assistant (PDA), or a memory stick device that uses an industry standard communication protocol and have sufficient memory to download the full of the data logger without copying the files to a host computer.

   Manual Retrieval via wireless shall download data from the machine using wireless connection, which shall:

   a. Use an industry standard communication protocol (e.g. Bluetooth)
   b. Download the collected data files
   c. Delete downloaded data files
   d. Operate within 50 meters from the device
   e. Be license exempt for its application

   Remote transmission via telephony shall make the complete operation of the machine available via software residing on a personal computer operating remotely via fixed land lines, GSM, GPRS, 34/4G data, mesh wireless. Functions to include, but not limited to, are:

   a. View and set time and date in data logger
   b. Monitor the operational state of the data collection
   c. Monitor real time view of data
   d. Monitor real time view of sensors
   e. Monitor the data logger available memory
   f. Download collected data files
   g. Delete downloaded data files
   h. Download revised classification schemes to the data logger

8. **Climatic environment:** The machine shall function normally in a temperature range from 0 to 50 degree Celsius (measured at the surface of the sensor). The data processor shall operate under temperature from 0 to 40 degrees Celsius.

9. **Portability:** The weight of the heaviest component/part shall not exceed 10 kg.

10. **Protection:** The machine shall be able to be fixed in place in a reasonably vandal-resistant manner.

11. **Power source:** The machine shall be designed for battery power supply and shall be able to operate continuously for no less than thirty (30) days without replacement of battery. In addition, the system shall be capable of being powered by an AC adapter from 90V – 130V/200 – 270V, whichever is applicable and where such power is available. The

supplier shall provide two (2) such AC adaptors per one (1) set as necessary. Solar powered systems may be established that enable continuous charging of the batteries.

627.3.1.3 Permanent (In-ground) Roadside Cabinet

An unobtrusive roadside enclosure providing a secure and vandal resistant cabinet and steel cage housing the ATC machine shall be provided. The enclosure shall be protected against the infestation of rodents or other vermin.

627.3.1.4 Temporary (Above-ground) Counter Relocation

The temporary ATC machine shall be suitable for relocation. For this reason, it shall be capable of being dismantled/constructed within one hour. All the components/parts shall not be heavier than 50 kg for the purpose of relocation. The entire system shall be capable of being transported by a pick-up truck with a cargo capacity of approximately 500 kg.

627.3.1.5 Temporary Protection

The temporary ATC is to be used outdoors. Accordingly, the entire system shall be sufficiently protected against heat of sunlight, rain, wind, dust, electric surge, lightning and other harmful action it receives when used outdoors. Where necessary, appropriate cover(s) for the equipment or any other device as well as two (2) locks and two (2) ruggedized chains for protecting the equipment from theft shall be provided.

627.3.1.6 Tools

At least two (2) sets of tools required for dismantling and constructing each set of temporary equipment for the purpose of relocation shall be provided.

627.3.1.7 Commissioning

The supplier shall be responsible for commissioning of the ATC including data processor, sensor, and other associated devices within 30 days of delivery.

627.3.2 Permanent Weigh-in-Motion (WIM) Equipment

Stationary, permanent slow and high-speed weigh-in-motion (WIM) stations shall be equipped with weighing equipment capable of recording both axle load and gross vehicle weight.

627.3.2.1 Functional Requirements

Permanent WIM shall comply with the following performance specifications:

1. **WIM Type and Accuracy:** The WIM type and accuracy shall be in accordance to ASTM E 1318 Standard Specifications for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Methods.

   The ASTM E 1318 specification defines WIM systems into four (4) types:

   - Type I – high accuracy data collection systems, typically bending plate scale type WIM at speeds from 16 to 130 km/hr

- Type II – lower cost data collection systems, typically piezoelectric scale type WIM at speeds from 24 to 130 km/hr
- Type III – systems for use in a sorting application at weigh station entrance ramps (bending plate or deep pit load cell type WIM) for weight enforcement at speeds from 16 to 130 km/hr
- Type IV – low-speed WIM for weigh enforcement at speeds from 3 to 16 km/hr

WIM Type	Accuracy		
	Single Axle	**Axle Group**	**Gross Vehicle Weight**
I	±20%	±15%	±10%
II	±30%	±20%	±15%
III	±15%	±10%	±6%
IV	5,400 kg ± 100	11,300 kg ± 500	27,200 kg ± 1,100

2. **Load to be measured:** Axle load and gross vehicle weight (GVW)

3. **Mode of measurement:** Slow and high speed weigh-in-motion.

4. **Measurable tread distance of vehicle:** 1.5 to 2.9 meters

5. **Capacity:** 30 tons per axle, shall be endurable for the maximum load of 40 tons per axle without mechanical and electrical damage

6. **Vehicle speed range:** Depending on WIM type ranging from 3 to 130 km/hr

7. **Vehicle speed measurement accuracy:** < 2%

8. **Display of measured data:** The measured data shall be displayed on a display device within two (2) seconds after measurement.

9. **Graduation:** 100 kg or less

10. **Print out:** The measures axle load/GVW shall be printed out, at the option of the operator, within 10 seconds after the measurement.

11. **Capacity for data storage:** Minimum 30,000 vehicles/ day/ lane with a minimum recording capacity of one (1) week

12. **Format of data retrieval:** Comma-separated value or other open format

13. **Climatic environment:** WIM shall function normally under the temperature from 0 to 50 degrees Celsius (measured at the surface of the sensor) and after submerged in water to the top of the sensor for 24 hours.

14. **Sensor life:** The sensor shall be functionally intact after 3,000,000 times of loading of 15 tons or more.

15. **Power source:** The system shall be powered by an AC adapter from 90V – 130V/200V – 270V. The supplier shall provide two (2) such AC adaptors per one (1) set of equipment as necessary.

16. **Uninterrupted Power Supply (UPS):** A UPS with sufficient capacity to supply electricity to the permanent WIM for 20 minutes shall be provided.

17. **Protection against electric surge:** The permanent WIM shall be protected against electric surge which occurs when the electricity recovers after power failure when lightning strikes the electricity supply system. The entire equipment of permanent WIM shall also be protected against strike of lightning.

627.3.2.2 Data Transfer

The data shall be transferred as described in Subsection 627.3.1.2.7 of this Specification.

627.3.2.3 Installation

The supplier shall submit for approval the detailed design of permanent WIM installation, including the manner of installation and structure of foundation.

627.3.2.4 Roadside Cabinet

An unobtrusive roadside enclosure providing a secure and vandal resistant cabinet housing the counter electronic recorder shall be provided. The cabinet shall be proof against the infestation of rodents. The supplier shall explain the proposed layout and size of cabinet proposed.

627.3.2.5 Commissioning

The supplier shall be responsible for installation and commissioning of the Permanent WIM including computer, printer, data processor, sensor, and other associated devices within 45 days of notice from the Agency that the site has been completely prepared and is ready for installation of the Permanent WIM equipment and associated equipment.

627.3.3 Portable Weighing Scales

Suitable for wheel and axle load surveys, the portable axle weighing systems shall consist of two (2) weigh pads and a separate electronic readout unit and be suitable for traffic axle load surveys.

627.3.3.1 Weigh Pad Features

1. **Weigh Pad Size:** The wheel weighing capacity of each weigh pad should be a minimum of 15,000 kg. Each weigh pad should measure not less than 700 mm x 500 mm in area and not exceed 35 mm in height and weigh less than 20 kg.

2. **Active Weighing Area:** The active weighing area of the weigh pad shall not be less than 700 mm x 400 mm. The active weighing area for static weighing shall be clearly delineated in the upper surface of each weigh pad. The delineated marking shall be permanent and resist scrubbing action of passing wheels.

3. **Load Application Footprint:** The design of the weigh pad should ensure the sensitivity of the weigh pad is immune to the effects of differing size of load applied footprint area when the load is applied within the active weighing area described above. The smallest footprint shall be 20 cm x 15 cm. The largest footprint shall be 70 cm x 30 cm.

4. **Weigh Pad Ruggedness:** The effects of uneven surfaces shall not unduly reduce the working life of the weigh pads. Partial warping caused by loads applied to the weigh pad when resting on poor surfaces shall not cause failure to the weigh pad mechanism. It shall be possible for a test shim of 10 mm height to be placed anywhere under the weigh pad and for a load of 5,000 kg to be applied to the weigh pad without causing irrevocable damage. Accidental dropping of the weigh pads during their life is inevitable. The weigh pad should be immune to knocks and bangs which would normally be expected for the weigh pad to receive whilst being set out and installed ready for a weighing operation. The weigh pad should also be able to withstand an average of at least three (3) Topple Drops[1] and three (3) Accidental Drops[2] per month. The weigh pads shall not fail when subjected to these drops or cause the zero balance output from the measuring transducers to exceed the zero range of any automatic zeroing system in use.

5. **Static and Dynamic Weighing:** The portable system should have the facility to weigh vehicles both statically whereby each axle is stopped on the weigh pads or dynamically whereby the vehicle is weighed without stopping at speeds up to 5 km/h.

6. **Weigh Pad Levelers:** If dummy ramps and platform levelers are required in the tender specification, the manufacturer shall provide levelers that extend to a distance of at least three (3) meters on either side of the weigh pads. The ramps at the end of the levelers should be of sufficient length to ensure that the ramp gradient does not exceed 4 degrees. The height of the levelers should be the same as the weigh pads to a tolerance of ± 0.5 mm.

7. **Connection to Readout Unit:** The weigh pad shall be connected to the readout unit via a cable or wireless connection. Systems which are designed to function with cables should have a facility whereby the cable runs from the outside weigh pad passing through a protected channel area in the nearside weigh pad. This ensures the outer weigh pad cable run is not driven over during surveying.

627.3.3.2 Weighing Readout

Each weigh pad shall display the axle weight. The separate readout unit should display both the wheel loads on each pad and the total axle load. The readout unit should have an integral printer that will print out the vehicle axle weights, gross weight, time and date, ticket number, number of axles and a space for manual entry of vehicle plate number. The ticket printer should not be a ribbon type and should print onto a rugged, ultra violet proof and tamper proof medium. A printed width of at least 60-mm should be used.

---

[1] **Topple Drop:** The non-handle end of the weigh pad is rested on concrete ground such that the weigh pad is perpendicular to the ground. A user holds the handle so that it does not topple over. The user moves his hand from the weigh pad and the weigh pad is free to fall in either direction.

[2] **Accidental Drop:** The weigh pad is dropped from a height of 0.5 meters onto concrete ground. The initial position before dropping is arbitrary.

The following are the minimum requirements for the readout unit:

1. **Display Resolution:** The readout should display the individual axle weights to a resolution of 10 kg or better. The internal resolution of the system should be better than 5 kg per weigh pad.

2. **Automatic Zero, Zero Tracking Rate, Zero Button and Zero Lamp:** The system shall incorporate an automatic tracking zero system to eliminate system zero drift caused by temperature and other effects. However, the maximum zero tracking rate shall not be more than 25 kg per second. A zero button used for the purposes of zeroing the display in the event of large offsets shall be incorporated. Its range of operation shall be confined to a maximum of 2,500 kg per weigh pad. A front panel zero lamp or indicator should illuminate/activate when the sum of the two weigh pad weights is less than 12.5 kg.

3. **Printed Information on Ticket:** The ticket printer that should be integral to the readout shall print out the following information:

    - Each individual axle weight.
    - The gross vehicle weight.
    - If the vehicle was over maximum speed a warning should be given.
    - The time and date.
    - Unique ticket number which cannot be reset.

627.3.3.3 Data Storage and Communication Facilities

1. **Data Storage:** The storage within the readout unit shall store the weighing results of at least 2,000 vehicles (or if recording by axle sufficient for 2,000 vehicles).

2. **Output:** The readout unit shall be able to transfer the stored data to an external PC as described in Subsection 627.3.1.2.7 of this Specification. The data format shall be comma separated value or other open format. The structure of the data format shall be clearly explained by the supplier in the operating manuals provided.

627.3.3.4 Battery Supplies – Readout Unit and Weigh Pads

1. **Readout unit:** The battery for the readout unit should be integral and it should not be a requirement to have to use an external battery. Facilities, however, for connection to an external 12-volt battery should be provided. Battery life shall be 40 hours minimum between charges. The battery technology used in the readout shall permit batteries to be charged whilst they are at any state of charge and without unduly compromising battery life. The supplier shall supply two (2) spare batteries for each readout unit.

2. **Weigh Pads:** The weigh pads should ideally obtain their operating supply from the readout unit via the connecting cables to between the readout and the weigh pad. If, however, the weigh pads run from battery power the requirements earlier shall apply.

3. **Battery charger:** The battery charger for the weigh pads and readout unit should accept an input from 90V – 130V AC/200 – 270V AC and should be capable of re-charging the weigh pads and readout unit within 8 hours. Each charger shall be supplied with two (2) AC adapters.

627.3.3.5 Slow Speed Weigh-in-Motion

The unit shall be able to be operated as a slow speed in motion system at speeds of maximum 5 km/h. The readout electronics shall calculate the individual dynamic wheel weight values from the weight profile as the wheel passes over. The measurement shall be taken when the wheel load is centrally located between the leading and trailing edges of the weigh pad. If either wheel load travels faster than 5 km/h over the weigh pad, the system shall unambiguously identify this so that the vehicle can be re-weighed if deemed necessary by the supervising operator.

627.3.4 Road Traffic Sensor

The ATC and WIM shall work with any or combination of the following road traffic sensors for the purpose of detecting vehicles passing through it:

1. Inductive loop cables

   An inductive loop is a square of wire embedded into or under the road utilizing the principle that a magnetic field introduced near an electrical conductor causes an electrical current to be induced. In the case of vehicle detection, a large metal vehicle acts as the magnetic field and the inductive loop as the electrical conductor. The ATC machine at the roadside records the signals generated.

2. Pneumatic road tubes

   Pneumatic road tube hoses are stretched across the road and connected at one end to the ATC machine, while the other end is sealed. When a pair of wheels pass through and hits the tube, air pressure in the compressed tube activates the ATC machine which records the time of the event. At least one road tube is needed for each direction on every road for traffic counting.

3. Piezoelectric axle sensors

   Piezoelectric axle sensors collect data by converting mechanical energy into electrical energy. The piezoelectric sensor is mounted in a groove cut into road's surface. When a car drives over the piezoelectric axle sensor, it squeezes it and causes a voltage signal. The size of the signal is proportional to the degree of deformation. When the car moves off, the voltage reverses. This change in voltage can be used to detect and classify vehicles.

4. Other sensor types not indicated herein subject for the approval of the Department.

   A minimum of two (2) road traffic sensors shall be installed in each traffic lane for the purpose of capturing axle spacing and vehicle speed information.

627.4 Construction Requirements

Safety of road users through a suitable worksite traffic management shall be considered for the entire duration of the installation. Temporary roadworks signs and traffic control devices

to be used shall adhere with the provisions of existing Department manuals, issuances, and policies.

For permanent locations with inductive loop vehicle detector system and/or piezoelectric axle sensors, the sensors shall be fixed in a groove cut on the pavement in accordance with ASTM E 2561 - Standard Test Method for Environmental Stress-Crack Resistance of Blow-Molded Polyethylene Containers for inductive loops and ASTM E 2415 - Standard Practice for Installing Piezoelectric Highway Traffic Sensors for piezoelectric sensors. It shall be functionally intact after loading of 10,000,000 times vehicles of mixed traffic.

For temporary traffic counting locations using pneumatic road tubes, the sensor shall be mounted on the pavement surface in accordance with ASTM E 1957 - Standard Practice for Installing Using Pneumatic Tubes with Roadway Traffic Counters and Classifiers. It shall be functionally intact after loading of 500,000 times vehicles of mixed traffic. The height of the sensor, including the material for fixing, when installed on the pavement surface, shall not exceed 2.5 cm.

The design of the sensors shall prevent reversed assembly or improper installation.

The sensors shall operate in a temperature range from 0 to 50 degrees Celsius.

627.4.1 Delivery, Storage and Handling

The ATC and/or WIM system shall be delivered, handled and stored as recommended by the manufacturer, together with the following provisions:

1. All components of the entire system shall be transported, handled, and stored carefully in such a way which avoids any physical damage.

2. It shall be inspected upon delivery and any damage shall be reported immediately to the Engineer.

3. Any component damaged during delivery, storage or installation shall be marked and set aside.

4. Proposals for repair of any damaged component shall be submitted in writing to the Engineer for approval.

5. No repairs to damaged component shall be attempted without the Engineer's approval.

6. Any damaged component deemed unsuitable for repair as suggested by the Engineer shall be removed from site and replaced at the Contractor's expense.

627.4.2 Calibration and Acceptance Testing

Final acceptance of the system shall be based upon successful completion of the calibration procedures at the required accuracy and confidence level.

627.4.2.1 Axle Sensor Based Technology

The survey equipment shall be validated at each site against a number of reference vehicles. This shall be done by measuring the reference vehicles axle spacing and confirming the axle spacings are correctly measured by the recording equipment and that they are placed in the correct vehicle classification bins by the equipment.

Vehicle speed measurement accuracy should be better than +5% coefficient of variation (COV) with an appropriate distribution around the mean value.

Inter axle spacing measurement accuracy should be better than +5% (COV) with an appropriate distribution around the mean value.

Traffic volume counts shall be +5% (COV) with an appropriate distribution around the mean value.

The vehicle classification system shall comply with the tender requirements. This shall be validated by observing vehicles visually and then confirming that they are correctly identified by the traffic classifier. Careful attention shall be paid to motorcycles and multi-axle vehicles as these are the most commonly misclassified. No more than 5% of the traffic volumes shall be misclassified.

627.4.2.2 Non-Contact Sensors

The survey equipment must be validated at each site against a number of reference vehicles. This is done by measuring the reference vehicles axle spacing and confirming the axle spacings are correctly measured by the recording equipment and that they are placed in the correct vehicle classification bins by the equipment.

Vehicle speed measurement accuracy should be better than +5% (COV) with an appropriate distribution around the mean value.

Occupancy shall be + 5% (COV) with an appropriate distribution around the mean value.
Traffic volume counts shall be +5% (COV) with an appropriate distribution around the mean value.
The vehicle classification system shall comply with the tender requirements. This shall be validated by observing vehicles visually and then confirming that they are correctly identified by the traffic classifier. No more than 5% of the traffic volumes shall be misclassified.

627.4.2.3 WIM System

Calibration and acceptance testing for the WIM system shall be in accordance with the provisions outlined under Section 7.6 of ASTM E 1318. The test shall be conducted on-site by the Engineer, in cooperation with the Contractor, immediately after WIM system has been installed or modified.

627.4.3 Warranty

As each sub-component which makes up the ATC and WIM systems may come from different suppliers with different warranties, a minimum warranty period of one (1) year is recommended for all components after final acceptance.

The supplier should warrant that the supplied equipment is free from defective materials and agrees to remedy any defects or to furnish a new part in exchange for any part supplied which, under normal installation, use and service discloses such defect, provided that the unit is examined by the factory or authorized agent. All transportation charges should be paid by the supplier, including those of the Department returning the parts.

If the equipment failure within the warranty period, the supplier should supply replacement within a specified period.

627.4.4 Training

Training should be an integrated part of the delivery of the equipment. The cost of the equipment shall include training of the Engineer in use and maintenance of the equipment and analyzing the results.

A comprehensive training course for the operators conducted by a qualified/trained professional shall be provided within 30 days of the initial commissioning covering the following topics:

1. Installation, maintenance and handling of the machines including the ATC and WIM machines, solar panels, batteries, and telecommunications (where applicable);
2. Quality assurance procedures for machine installation, setup, maintenance and ongoing data collection;
3. Data collection procedures;
4. Processing and analysis of data;
5. Operation of data download machine and associated software;
6. Updating of data collection software.

Competence certificate, brochures, and operations and maintenance manuals for each participant trained shall be provided upon completion of the training period.

627.5 Method of Measurement

The work under this Item shall be measured by lump sum, lot, slot, and unit of what is actually placed and installed as shown on the approved Plans and accepted to the satisfaction of the Engineer.

627.6 Basis for Payment

All works performed and accepted quantity measured as prescribed in Subsection 627.5 - Method of Measurement shall be paid for at the contract unit price for each of the particular item listed in the Bill of Quantities, which price and payment shall constitute full compensation for the supply and installation of the ATC equipment, road sensors and all associated accessories, civil and maintenance works, commissioning, testing, training, and other incidentals necessary to complete the work prescribed in this Item.

Payment will be made based on the following pay items of work:

Pay Item Number	Description	Unit of Measure
627 (1) a1	Supply and Install Road Sensors, 2 lanes (Loop-piezo-loop)	Lot
627 (1) a2	Supply and Install Road Sensors, 4 lanes (Loop-piezo-loop)	Lot
627 (1) a3	Supply and Install Road Sensors, 6 lanes (Loop-piezo-loop)	Lot
627 (1) a4	Supply and Install Road Sensors, > 6 lanes (Loop-piezo-loop)	Lot
627 (1) b1	Supply and Install Road Sensors, 2 lanes (Dual piezo)	Lot
627 (1) b2	Supply and Install Road Sensors, 4 lanes (Dual piezo)	Lot
627 (1) b3	Supply and Install Road Sensors, 6 lanes (Dual piezo)	Lot
627 (1) b4	Supply and Install Road Sensors, > 6 lanes (Dual piezo)	Lot
627 (2) a1	Supply and Install Automatic Traffic Counter/Classifier (ATC), 2 lanes (ATC without solar)	Lot
627 (2) a2	Supply and Install Automatic Traffic Counter/Classifier (ATC), 4 lanes (ATC without solar)	Lot
627 (2) a3	Supply and Install Automatic Traffic Counter/Classifier (ATC), 6 lanes (ATC without solar)	Lot
627 (2) a4	Supply and Install Automatic Traffic Counter/Classifier (ATC), > 6 lanes (ATC without solar)	Lot
627 (2) b1	Supply and Install Automatic Traffic Counter/Classifier (ATC), 2 lanes (ATC with solar)	Lot
627 (2) b2	Supply and Install Automatic Traffic Counter/Classifier (ATC), 4 lanes (ATC with solar)	Lot
627 (2) b3	Supply and Install Automatic Traffic Counter/Classifier (ATC), 6 lanes (ATC with solar)	Lot
627 (2) b4	Supply and Install Automatic Traffic Counter/Classifier (ATC), > 6 lanes (ATC with solar)	Lot
627 (3) c1	Supply and Install Automatic Traffic Counter/Classifier (ATC) with Remote Access Unit, 2 lanes	Lot
627 (3) c2	Supply and Install Automatic Traffic Counter/Classifier (ATC) with Remote Access Unit, 4 lanes	Lot
627 (3) c3	Supply and Install Automatic Traffic Counter/Classifier (ATC) with Remote Access Unit, 6 lanes	Lot
627 (3) c4	Supply and Install Automatic Traffic Counter/Classifier (ATC) with Remote Access Unit, > 6 lanes	Lot
627 (3) c5	Complete Installation of Local Wiring and Connection to ATC, Commissioning and Testing	Lot
627 (4) a	Supply and Install ATC Software	
627 (5) a	Supply and Install Solar Panel	Lot
627 (6) a1	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 2 lanes (Type I)	Lot

Pay Item Number	Description	Unit of Measure
627 (6) a2	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 2 lanes (Type II)	Lot
627 (6) a3	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 2 lanes (Type III)	Lot
627 (6) b1	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 4 lanes (Type I)	Lot
627 (6) b2	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 4 lanes (Type II)	Lot
627 (6) b3	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 4 lanes (Type III)	Lot
627 (6) c1	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 6 lanes (Type I)	Lot
627 (6) c2	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 6 lanes (Type II)	Lot
627 (6) c3	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, 6 lanes (Type III)	Lot
627 (6) d1	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, > 6 lanes (Type I)	Lot
627 (6) d2	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, > 6 lanes (Type II)	Lot
627 (6) d3	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, > 6 lanes (Type III)	Lot
627 (7) a	Supply and Install Permanent Type Weigh-in-Motion Axle Scale, Type IV	Lot
627 (8) a	Supply and Install Portable Weighing Scales	Lot
627 (9) a	Supply and Install WIM CPU/Console	Lot
627 (10) a	Supply and Install LED Display	Lot
627 (11) a	Complete Installation of Local Wiring and Connection to CPU/Console, Commissioning and Testing	Lot
627 (12) a	Supply and Install WIM Software	Lot
627 (13) a1	Automatic traffic counter/classifier (ATC), In-ground survey type	Set
627 (14) a2	Automatic traffic counter/classifier (ATC), On-ground survey type	Set
627 (15) a	Pneumatic road tubes	Roll
627 (16) a	Road tube cable grip, Figure 8	Piece
627 (16) b	Road tube cable grip, Woven cable	Piece
627 (16) c	Road tube cable grip, End C-clamp	Piece
627 (17) a	Road tube anchor, Center plate clamp	Piece
627 (17) b	Road tube anchor, Center lane flap	Piece
627 (17) c	Road tube anchor, Bitumen tape	Roll
627 (18) a	Replacement road case	Piece

Pay Item Number	Description	Unit of Measure
627 (19) a1	Battery pack, 6 V 4.5Ah	Piece
627 (19) a2	Battery pack, 6 V 12Ah	Piece
627 (19) b1	Battery pack, Welded 6 V	Piece
627 (19) b2	Battery pack, 36 Ah	Piece
627 (20) a	Inductive loop detector cable	Roll
627 (21) a	Piezoelectric axle sensor, Type I	Set
627 (21) b	Piezoelectric axle sensor, Type II	Set
627 (22) a	Remote access hardware	Set
627 (23) a	Solar panel	Set
627 (24) a	WIM strip scale	Piece
627 (25) a	Portable Weigh-in Motion Axle Scale (PWIM)	Piece
627 (26) a	Weighing scale indicator	Piece
627 (27) a	Load cell	Piece
627 (28) a	External axle weight/ticket printer	Piece
627 (29) a	Roll-up ramp/levelling pad	Set
627 (30) a	Conductor cable with shield	Set
627 (31) a	Concrete bollard/protection post	Unit
627 (32) a	Roadside Cabinet or Protection Cage with Identification Plate	Unit
627 (33)	Weigh-In-Motion (WIM) Systems	Lump Sum
627 (34)	Automatic Traffic Counter/Classifier (ATC) Equipment	Lump Sum

References

1. Technical Specifications for WEIGH-IN-MOTION (WIM) SYSTEMS AND AUTOMATIC TRAFFIC COUNTER/CLASSIFIER (ATC) EQUIPMENT – based on the submitted documents/references of the Bureau of Quality and Safety
2. ASTM Standards: Designation E 1318-02, Standard Specification for Highway Weigh-In-Motion (WIM) Systems with User Requirements and Test Methods.
3. Generic Equipment Specifications Weigh-in-Motion and Traffic Counting. 2006. The World Bank East Asia Pacific Transport Unit.
4. NRTSP Traffic Data Collection Manual Version 3. 2015. Department of Public Works and Highways.
5. DPWH Highway Planning Manual. Chapter 10 Vehicle Classification and Data Collection.
6. METROCOUNT ROADPOD VP (MC5710) Vehicle Piezoelectric Counter Product Evaluation Report of Bureau of Quality and Safety.