

Section 691—Weigh-in Motion Scale System

691.1 General Description

This work includes furnishing and installing weigh-in-motion system in truck weighing stations according to the Plans and Specifications.

The Department's objective is to have a system that automatically pre-selects vehicles in motion for weighing, then automatically directs the vehicles to the enforcement scales.

691.1.01 Definitions

General Provisions 101 through 150.

691.1.02 Related References

A. Standard Specifications

[Section 101—Definitions and Terms](#)

[Section 105—Control of Work](#)

[Section 108—Prosecution and Progress](#)

[Section 109—Measurement and Payment](#)

[Section 500—Concrete Structures](#)

[Section 511—Reinforcement Steel](#)

[Section 680—Highway Lighting](#)

[Section 923—Electrical Conduit](#)

B. Referenced Documents

Scale Manufacturer's Association Handbook 44

Insulated Power Cable Engineers' Association Specifications

National Bureau of Standard Handbook 44

Code of Public Transportation, State of Georgia

691.1.03 Submittals

After the Contract is awarded, submit the items listed below to the Engineer for approval.

Allow the Department 60 days for review of materials, equipment, shop drawings and other manufacturer's data.

When the Department approves the Shop Drawings and other items listed herein, assume responsibility for furnishing material or performing Work as required by the Plans and these Specifications. Meet the requirements of the acceptance performance test (APT) according to [Subsection 691.3.06](#).

A. Equipment Performance Supporting Data

Furnish documentation according to [Subsection 691.3.07](#) that demonstrates to the Department's satisfaction that equipment proposed for use in the weigh-in-motion scale system:

- Is of standard manufacture
- Has been available for purchase for at least two years
- Has a proven acceptable performance history under conditions similar to those for the intended use

Include the following information with the equipment documentation:

- Detailed descriptions of how the system requirements will be met
- Drawings showing control and display panels with descriptions
- Description of a similar installation with the standard package components described in [Subsection 691.2.A](#) that has been in use for at least 1 year or has satisfactorily completed one project for the Department, including:

Section 691—Weigh-in Motion Scale System

- The owner’s name
- Owner’s address
- A contact name
- A contact telephone number

B. Demonstration

Demonstrate to the Department, by means of a pre-existing weigh-in-motion system which has been fabricated with the component equipment to be used on this project, that the Contractor has successfully provided and installed a weigh-in-motion system which is fully operative and has been in use for not less than one year, and is meeting the weighing performance requirements in [Subsection 691.3.06 “Quality Acceptance.”](#)

Upon request by the Engineer, arrange the pre-existing system demonstration and furnish operations performance data to the Department within 10 days after the request.

The Department will, at its option and expense, provide selected persons to view the demonstration.

C. Manufacturer’s Data

Along with the materials and equipment list, submit manufacturer’s catalogs, cuts, diagrams, performance curves, charts, and other data demonstrating that equipment complies with the Specifications and Plans. Model numbers alone are not acceptable.

D. Warranty

Before beginning work, furnish a written warranty for the static scale system according to [Subsection 691.3.07](#).

E. Manufacturer’s Guarantees and Instructions

Submit manufacturer’s guarantees on materials and equipment as well as manufacturer’s instruction manuals. The Engineer will transmit these to the Department for future operation and maintenance of the truck scale system. Ensure guarantees are subject to transfer.

F. Brand Names or Equal

Materials and equipment designated on the Plans or Specifications as “brand names or equal,” may be substituted for equal materials with the Engineer’s approval. Submit the name and complete description of the equal material or equipment in writing. Also submit supporting data for equipment performance.

691.2 Materials

A. Weigh-in-Motion Scale Components

The work includes, but is not limited to, the following standard package components. Construct accessories as shown on the Plans and as described in these Specifications.

- Electronic weighing platform(s)
- Speed-presence detectors, inductive loop type with:
 - Presence detector loops
 - Speed detector loops
- Weight indicator, recording elements, and control unit with digital processor
- Over-height detector
- Traffic control subsystems

Components will automatically pre-select vehicles with one of the following conditions for legal static weighing or over-dimension measuring:

- Exceeds manually entered threshold axle or gross weight
- Exceeds bridge formula weight and axle spacing limitations according to [Subsection 691.3.06.A](#)
- Is within 6 in (150 mm) or above of the maximum height limitation as set forth herein

B. Electronic Axle Load Scale Plans

Ensure that materials and equipment for this work conform to the electronic axle load scale plans and these Specifications. The Contractor’s attention is directed to [Subsection 105.04.A, “Specifications of Other Organizations.”](#)

Section 691—Weigh-in Motion Scale System

C. Scalepits and Weighing Platforms

Use scale pits and weighing platforms as follows:

1. Scale Pits

Furnish the structural design of and install scale pits. Ensure that the one-time overload capacity without structural failure is at least 300 percent of the legal axle load limit.

2. Weighing Platforms

Furnish and install weighing platforms with a minimum load capacity of at least 200 percent of the legal axle load limit.

D. Inductive Loops

Furnish and install inductive loops in existing concrete pavement according to [Subsection 691.3.05.B](#).

E. Weight Indicator, Recording Elements, and Control Unit with Digital Processor

Refer to [Subsection 691.3.05.C](#).

F. Traffic Control Subsystem

Furnish and install the traffic control subsystem according to the Plans, these Specifications, and [Subsection 691.3.05.D](#).

G. Conduit and Cable with Electrical Wiring

Furnish and install cables according to the NEC, Section XV of the National Bureau of Standards Handbook 44, the Plans, Subsection 691.3.05.E, and the following:

1. Rigid Steel Conduit: Use according to [Subsection 923.2.01.A.2](#).
2. Non-metallic conduit: Use according to [Subsection 923.2.02](#).
3. Flexible conduit: Use flexible conduit with these features:
 - Galvanized steel core
 - Liquid tight jacket of polyvinyl chloride (PVC)
 - Continuous copper bonding conductor wound spirally between the convolutions
 - UL approved flexible conduit
4. Use wire and cable that conforms to the applicable sections of the IPCEA (Insulated Power Cable Engineers' Association) Specifications S-19-81.

Use pull and junction boxes according to [Subsection 680.3.05.B](#).

691.2.01 Delivery, Storage, and Handling

Do not use the interstate Right-of-Way outside the truck weighing station to store equipment or supplies.

691.3 Construction Requirements

691.3.01 Personnel

A. Training

During the acceptance testing period following installation, train at least 10 Department-designated people to operate and maintain truck weighing station systems.

B. Assistance During APT

Provide a trained static scale system specialist to assist in system operation for approximately one week during the APT. (See [Subsection 691.3.06.D](#).)

691.3.02 Equipment

General Provisions 101 through 150.

691.3.03 Preparation

Truck weighing station construction may be in progress. Coordinate operations with utility companies and other contractors to complete the work quickly.

Section 691—Weigh-in Motion Scale System

691.3.04 Fabrication

General Provisions 101 through 150.

691.3.05 Construction

A. Scalepit(s) and Weighing Platform(s)

Construct the scale pits in existing pavement and base material as shown on a typical section according to [Section 500](#) and [Section 511](#) and as follows. Closely coordinate efforts with other contractors.

1. Install a drain line to an outlet beyond the shoulder pavement.
2. Make the entire weigh-in-motion scales flush with the pavement. Ensure that the completed scales do not rock or hammer.
3. Hermetically seal and treat the load cells to prevent moisture penetration and corrosion under normal pit conditions.

B. Inductive Loops

Saw cut pavement, install the loop wires, and seal the saw cuts to the Engineer's satisfaction.

Provide a loop detector in the bypass lane that detects a vehicle that was directed by the automatic sorting system to proceed to the static axle scales but has incorrectly proceeded to the bypass lane.

Equip the loop detector to activate a buzzer at the operator's console to alert the operator.

C. Weight Indicator, Recording Elements, and Control Unit with Digital Processor

Furnish and install the weight indicator, recording elements, and control unit with a digital processor in the operations office that will be provided by others.

Others will install the heating and air conditioning system in the operations office environment where the equipment will perform.

1. Electrical Service

Electrical service provided by others in the operations office will be 115-volt, 60 hertz (plus or minus 2 hertz), single phase service. Provide for power connections from panel board "A" to the equipment in the operations office.

2. Threshold Indicators

Furnish and install detection devices that use overhead traffic control signs to automatically direct vehicles to the static system under the following conditions:

- The vehicle exceeds an operator-entered threshold speed when passing over scales.
- The vehicle is out of position so that all wheels do not pass over the scales.

Provide thumb wheel switches or a keyboard on the operator's console so that threshold weights for axle and gross weights can be entered into the instrumentation.

When the operator-entered threshold weights are exceeded, have the instrumentation automatically activate the overhead traffic control sign and eye level, pole-mounted sign directing the pre-selected vehicle to the static scale system.

3. Control Signs and Indicators

Provide a high-intensity light on the back of each overhead signal head that will illuminate at the same time the green arrow is illuminated. Install two repeater pin lights at the weigh-in-motion console that indicate the vehicle has been directed to the static scales or the bypass lane.

Provide a manual switch in the operations office to override the automatic mode of the overhead signs.

4. Statistical Data Printer

Equip the operator's console with a microprocessor with changeable program that stores, recalls, and provides statistical data in hard copy via a printer.

The printer shall print at the operator's discretion the weight indicator video display identifying axle weights, axle spacing, length of vehicle, and gross weights to include data/time and velocity for each vehicle weighed in motion.

Equip the printer to print axle and gross weight data in no more than three seconds.

5. Selection Distance

Program the instrumentation to pre-select successive vehicles one second or more apart from tail to head.

Section 691—Weigh-in Motion Scale System

6. Automatic Zero

Provide automatic zero tracking along with an adapter connection for “field changing” the indicating and recording weight units from pounds to kilograms.

D. Traffic Control Subsystem

Furnish and install the following components:

1. Lamps

Furnish and install reflector lamps using International Traffic Engineers colors in red for the “X” and green for the arrow.

- Use signals capable of the number of indications shown on the Plans and clearly visible at 1/4 mile (400 m) under normal atmospheric conditions.
- Use lamp sockets and lamps that are UL approved for outdoor service.
- Use lamps rated at 120 volts with a manufacturer’s life expectancy of no less than 1,500 hours.

Ensure that if two lamp bulbs fail, the lamp continues to indicate the proper signal.

2. Lighting Effects

Provide control signals with hinged and ventilated protective sun screens to eliminate “phantom” effects from unlighted lamps. Screens also protect the signal lamps from damage from thrown objects and birds.

3. Other

Furnish and install poles, cables, guys and anchors, and appurtenances including controls and electrical connections between the operations office and the overhead signs and cable.

E. Conduit and Cable with Electrical Wiring

Install cables in rigid galvanized steel or schedule 40 polyvinyl chloride (PVC) conduit between load cells, junction boxes, and electronic instrumentation. Install only smooth, standard dimension conduit according to the following:

- In exposed outside areas, install rigid galvanized steel conduit unless otherwise indicated.
- In underground areas, install rigid galvanized steel or schedule 40 PVC conduit.
- For inside areas other than installations in concrete slabs, install electrical metallic tubing (EMT) conduit, if desired.

Make conduit connections to moveable or vibrating equipment with the correct length of flexible conduit.

1. Installation Procedures

Install conduit as follows:

- a. Use at least four 1 in (25 mm) rigid galvanized steel conduits to attach the electrical junction box at the operator’s console to a ground-mounted junction box 5 ft (1.5 m) from the building. The junction box is provided by the Building Contractor.
- b. Shield the electronic cable connecting the transducers and instrumentation. Interconnect and carry shields to a single common ground.
- c. Use a ground separate from the power source ground. Provide it for the transducer/ instrumentation only.
- d. Environmentally seal transducer and underground connector cable connections.

2. Grounding System

Furnish and install surge voltage lightning protection consisting of 8 ft (2.4 m) grounding rods at each transducer load cell location, at the balance box(s), and at the instrumentation input. Ensure that the grounding system meets National Electric Code requirements.

Ground the scale platforms at 4 locations with 5/8 in (16 mm) diameter grounding rods 8 ft (2.4 m) long and a continuous length of ground bus. Ground each platform at least once.

3. Instrument Input

Provide the instrument input, balance box(s), and each pair of transducer load cells with fast acting, two-stage shunting circuitry and surge capacity that are compatible with the transducers and electronic components.

Ensure that the surge voltage lightning protection system is electrically passive at normal circuit operating voltage and returns to a passive state after the surge voltage has been shunted. The shunted circuitry shall be capable of being tested and repaired independently of the scale operating parts and circuitry.

Section 691—Weigh-in Motion Scale System

691.3.06 Quality Acceptance

A. Scale Performance Requirements

Ensure that the weigh-in-motion scale system automatically and accurately weighs each axle of a multi-axle vehicle (up to 11 axles) within the tolerances given in this subsection. Ensure that the system establishes the gross weight of the vehicle by totaling the individual axle weights.

Vehicle weight is defined as the vehicle weight established by static weighing on axle load scales with an acceptance tolerance of 0.1 percent of test load according to the National Bureau of Standard Handbook 44. Use the axle load truck scales regularly used for enforcement weighing within the truck weighing station.

Ensure that the system's measurement of the distance in feet (meters) between two or more consecutive axles on 65,000 lbs (29 483 kg) vehicles (gross weight) is within 5 percent of a distance measured by permits and enforcement officers using standard measuring equipment and techniques.

Ensure that 90 percent of the vehicles checked for compliance with the bridge formula outlined below are measured to this accuracy.

1. Bridge Formula

Have operators confirm that the system checks vehicles with a gross weight of 39,000 lbs (17 690 kg) or more for compliance with the "Bridge Formula" provisions of Chapter 32-6, Article 2, Section 32-6-26 of the Code of Public Transportation, State of Georgia.

2. Speed and Rate of Vehicles

Build the weighing system to perform the above functions while up to 12 vehicles per minute pass in motion over the scales.

Ensure that weights are accurate as a variety of multiple axle trucks pass over the scales at speeds from 10 mph to 55 mph (15 to 90 kph)

3. Gross Weight

Ensure that the scales accurately establish the vehicle gross weight as follows:

- At speeds above 10 mph (15 kph), within plus or minus 5 percent of the actual vehicle gross weight and within a 90 percent confidence level
- At speeds below 10 mph (15 kph), within plus or minus 2 percent of actual vehicle gross weight within a 95 percent confidence level

4. Axle Weight

Ensure that the scales establish vehicle axle weights as follows:

- At speeds above 10 mph (15 kph), within plus or minus 10 percent of the vehicle axle weight and within a 75 percent confidence level
- At speeds below 10 mph (15 kph), within plus or minus 5 percent of the vehicle axle weight and within a 75 percent confidence level

5. Accuracy Limits

Ensure 75 to 100 percent of load limits up to 20,340 lbs (9226 kg) for a single axle weight and 80,000 lbs (36 287 kg) for gross vehicle weight.

6. Environmental Conditions

Ensure that the weigh-in-motion system operates under typical environmental conditions experienced in the state of Georgia.

7. Over-Height Detection Device

Include the following over-height detection devices with the scale system:

a. In the Vicinity

Install an over-height detection device near the scales to detect vehicles 13 ft (4 m) high or more (adjustable to 13 ft, 6 in [4.1 m]). Ensure that this detector operates under the same conditions of vehicle speeds, numbers of vehicles per minute, and environmental conditions required for other components of the system. Have the system automatically direct vehicles at or above the present height limit to the static scales.

b. At the Approach

Section 691—Weigh-in Motion Scale System

At the approach to the static scales used for enforcement weighing, where indicated on the Plans, install another over-height detection device that will detect a vehicle 13 ft, 6 in (4.1 m) high or more. Install a momentary adjustable volume audible alarm and a red light set to blink for 5 seconds in the operator's office to alert the operator of a possible over-height violation.

B. Time is of the Essence

Time is of the essence in this Contract. Complete installation and testing on or before the Project completion date and be ready for the Department's acceptance performance test.

1. Failure or Delay in Completing Work on Time

The Contractor's attention is directed to [Subsection 108.08, "Failure or Delay in Completing Work on Time."](#)

Liquidated damages for each day of Project overrun will start on the day after the Project completion date if the installation is not complete and ready for the APT.

Liquidated damages will stop when the APT begins.

At the end of the APT period, if the weigh-in-motion scale system as described on the Plans and these Specifications does not perform to the satisfaction of the Department, the Department reserves the right to continue testing or reject the entire system.

2. Removal of Equipment

If the Department rejects the entire weigh-in-motion scale system, the Contractor may remove the electronic weighing platform(s), weight indicator, recording elements, and control unit with digital processor.

The Contractor may not remove inductive loops, traffic control subsystem overhead signs, conduit, and cable with electrical wiring. These will become the Department's property.

C. Testing

Before the APT begins, run calibration and performance tests on the weigh-in-motion scale system with weights certified and calibrated according to Georgia Department of Agriculture standards.

The weigh-in-motion scale platforms will be statically calibrated to plus or minus 1 percent (between 1,000 lbs and 6,000 lbs [454 kg and 2724 kg]) when the weights are uniformly distributed over two 100 in² (0.065 m²) areas anywhere on the scale platforms

Measure for acceptance tolerances according to [Subsection 691.3.06.A](#).

D. Acceptance Performance Test (APT)

The APT shall demonstrate to the Department's satisfaction that the weigh-in-motion scale system consistently meets the performance requirements of the Plans and Specifications.

Submit a test plan to the Department for approval within thirty 30 days after Notice to Proceed.

The APT period shall begin on the first normal working day following completion, calibration, and testing of the installation.

During the APT period:

1. The Department will operate the weigh-in-motion pre-selection system for approximately 8 hours per day, 5 days per week for 8 consecutive weeks.
2. Department personnel will check the calibrated performance by obtaining actual vehicle weight samples.
3. Provide a trained static scale system specialist to assist in the APT operation for approximately one week.

691.3.07 Contractor Warranty and Maintenance

A. Weigh-in-Motion Scale System Warranty

Before beginning construction, warrant the weigh-in-motion scale system equipment in writing against defective material and workmanship.

Furnish the written warranty to the Department when submitting Shop Drawings for approval. Include the provision that warranties are subject to transfer to the Department.

Warrant that for 6 months from the beginning date of the APT the equipment will perform according to [Subsection 691.3.06.A](#), operating as intended under conditions required for the equipment.

Section 691—Weigh-in Motion Scale System

Have the written warranty accepted and approved by the Department before beginning installation of the weigh-in-motion scale system.

The warranty excludes damage caused by fire, flooding, lightning, accidents, vandalism, or natural disasters.

Provide warranty service within 48 hours of notice that warranty work is required, excluding weekends.

691.4 Measurement

This work will not be measured separately for payment

691.4.01 Limits

General Provisions 101 through 150.

691.5 Payment

The weigh-in-motion scale system as described above will be paid for at the Contract Lump Sum Price. Payment is full compensation for all materials, equipment, labor, tools, superintendence, and incidentals necessary to complete the Item according to the Plans and Specifications. Payment also includes calibration and testing, acceptance performance testing, a 6-month warranty, and Department personnel training.

A percentage of the Contract Lump Sum Price will be paid according to the following cost schedule:

Completion of installation, calibration, and testing of the entire weigh-in-motion scale system	35%
Completion of the acceptance performance test to the satisfaction of the Department.	65%

Payment will be made under:

Item No. 691	Weigh-in-motion scale system truck weighing station _____	Per lump sum
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691.5.01 Adjustments

If the APT does not demonstrate that the performance requirements of the Plans and Specifications have been successfully accomplished to the satisfaction of the Department, and the Department rejects the entire weigh-in-motion scale system, payment to the Contractor will be limited to 35 percent of the Contract Lump Sum Price.