SETUP AND OPERATIONAL PROCEDURE FOR THE WEIGH-IN-MOTION SYSTEM

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I. Introduction

The following documentation calls out the procedure to setup and operate the Weigh-in-Motion (WIM) System developed by the Oak Ridge National Laboratory for use as a low speed weight-in-motion system (WIM) for pneumatic tired vehicles. This system will weigh vehicles up to 40,000 lbs per axle and calculate center of balance for a vehicle or vehicle combination (i.e. tractor-trailer).

II. Safety

- Before attempting to configure the WIM system for operation, read this setup and operational procedure completely. Do not proceed if you do not completely understand each step.
- Special care is required when handling the transducers to prevent damage to the attached cables. Do not drop or stand the transducers on end.
- **Caution - the transducers weight ~150 lbs each.** Use the appropriate number of personnel to safely hand equipment of this weight.
- Personnel should don appropriate safety equipment including leather gloves and safety toed shoes.
- The area to be used for the weighing of vehicles should be cordoned off to prevent injury to other people in the area or accidents with other vehicle traffic.

III. Component Description and Use

Tapered Ramp (4 ea. Required)
The tapered ramp is used to bring the vehicle to be weight up to the height of the transducer and minimize oscillation of the vehicle suspension. The ramps should be positioned with the letter “P A T” facing upwards (see figure 1).

Leveling Pad (14 ea. Required)
The leveling pad is used to keep the vehicle level during the weighing process to prevent weight from being shifted to another axle due to the angle of inclination from the axle being weighed and an axle before or after the transducer (see figure 1).

Transducer Pad (2 ea. Required)
The transducer pads are the sensors that convert the downward force (weight) of the vehicle to an electronic signal via strain gauges (see figure 1).

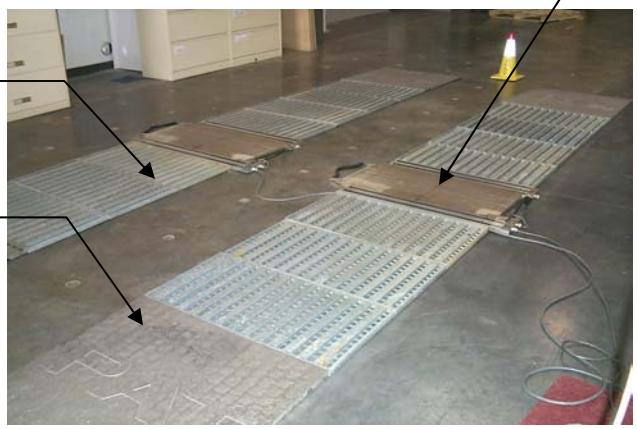


Figure 1 – Transducers and Ramps

CPU Cabinet (1 ea. Required)
The CPU cabinet houses a computer that converts the strain gauge signal from the transducer into a discernable weight and displays it on the monitor and hand-held control unit. It also contains a hard disk to store weight data (see figure 2).

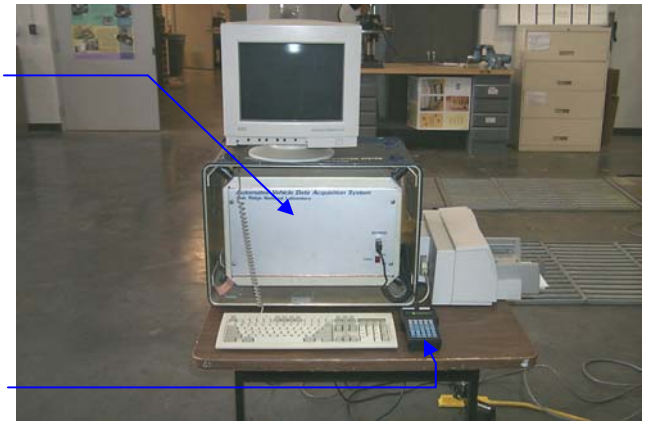


Figure 2 – Operator's Station

Printer (1 ea. Required)
The printer is used to obtain a hard copy of WIM data when desired (see figure 2).

Monitor (1 ea. Required)
The monitor is used to gain a better visual of data. It displays a graphic of the weighed vehicle and the center-of-balance (see figure 2), but is not essential to the operation.

Hand-held Control Unit (1 ea. Required)
The hand-held control unit is used to "set" the WIM system for weighing and will display data from each run (see figure 2).

Keyboard (1 ea. Required)
The keyboard is used in input the vehicle ID number before each run (see figure 2).

IV. Setup

Figure 3 – Pad Placement

Step 1 – Site Selection

Site selection is a very important consideration when preparing the WIM system for operation. The surface should be flat (1/2% end-to-end) and concrete or asphalt. 170 ft of flat surface is required: 100 ft leading up to the WIM system, 20 ft for the actual WIM system, and 50 ft leading away from the WIM system.

Step 2 – Pad Placement

Transducer pads are marked as sensor 1 and sensor 2 with direction of travel and transducer centerline called out. Sensor 1 must be placed on the driver's side (U.S., left) relative to direction of travel and sensor 2 must be placed on the passenger's side U.S., right) relative to the direction of travel (see fig 3).

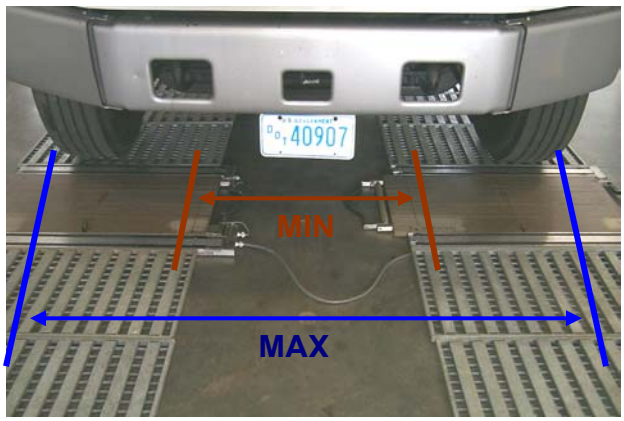
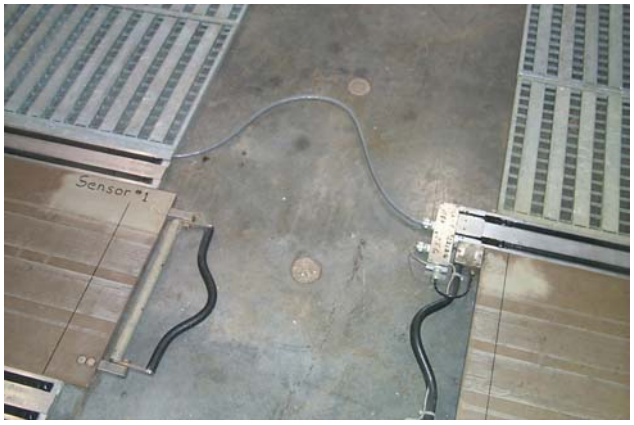


Figure 4 – Transducer Centerline and Boundaries

Measure from centerline-to-centerline of each sensor and set the separation at ~70 in. as shown in figure 4. This should accommodate most vehicles. Check each vehicle type before driving over the WIM system to be sure that the vehicle's tires stay within the inside and outside boundaries marks on the transducer pads see figure 4).

Next place four leveling grids prior to each transducer pad and three leveling grids after each transducer pad. Place a tapered ramp leading onto and off of each set of leveling grids. Note: One leveling grid has a special cable conduit attached (cable conduit painted white)to it to allow the power and intelligence cable from sensor 2 to pass across sensor 1's leveling grids without being damaged (see figure 5).

Figure 5 – Cable Feedthrough



The cable from sensor 2 should be routed in this conduit and the leveling grid place immediately after sensor 1 relative to the direction of travel (see figure 6).

Be sure that the cable is completely contained in the conduit and is not pinched under the leveling grid. Leave some cable slack between the sensors. Make Sure the cable slides freely through the conduit slot to insure there is no pinch point.

Figure 6 – Cable Conduit and Slack

Step 3 – Operators Station Placement and Configuration

Set up a table at least 12 feet from sensor 1 and at a 45-degree angle to the approach ramps in a position that allows the operator clear view as each vehicle passes over the transducer. Remove the covers from each end of the CPU cabinet and place the CPU cabinet on the table with the power switch facing towards the transducer and the operator position and the sensor connections facing away form the transducers. Place the CRT monitor on top of the CPU cabinet and the keyboard in front of the CPU cabinet. Next, place the printer beside the CPU cabinet along with the controller keypad.

Step 4 – Connect Power and Sensor Cables

Using figure 7 as a guide, connect sensor 1 and sensor 2 cables. The cables and the connectors are labeled. Connect sensor 1 cable to the sensor 1 connector on the CPU cabinet and the sensor 2 cable to the sensor 2 connector. Next connect the printer cable, monitor/video cable, and the keyboard cable. Plug printer and monitor into 120 vac, 60 Hz, 3-amp minimum, GFI protected outlet. Connect the controller keypad cable to the front (side facing operator) of the CPU cabinet. Connect the controller power cord to the rear of the CPU cabinet next to the fuses. Connect power cord to 120vac, 60Hz, 5-amp minimum, GFI protected outlet.

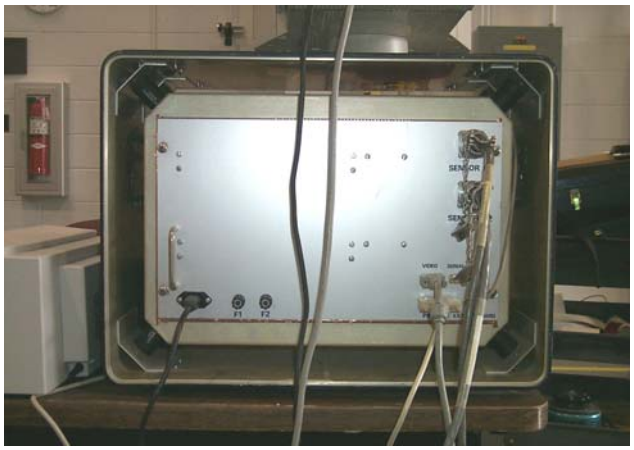


Figure 7 – Rear Cable Connections

Step 5 – Power up

Once all cables have been connected, the system is ready for power-up. Turn on the monitor. Next press, and hold in for about 2 seconds, the small black button on the left side of the hand-held controller keypad (See figure 8). On the front of the CPU cabinet turn the power switch on. The computer within the CPU Cabinet will boot up automatically. Watch the monitor, wait unit the WIM system software screen appears. The unit will come on displaying the system is now ready for use.

Figure 8 – Hand-held Control Unit On/Off Switch

Step 6 – System Operation

Using figure 9 as a guide, push “A” on the hand-held controller to start data collection for vehicle to be weighed. The system will prompt user for vehicle ID number. From the keyboard enter vehicle ID number and press enter. The hand-held controller will now say “weighing vehicle.” Direct the vehicle to be weighed across WIM. Note: vehicles should cross the scale at speeds from 3 to 7 mph. The speed should be as constant as possible until the entire vehicle has passed on the transducers. Once the vehicle has passed over the transducers, press “A” again on the hand-held controller. The hand-held controller will display “saving to disk” and “calculating run”. A run number is assigned automatically by the CPU for record-keeping purposes. Once the weight data appears on the screen, it can be printed by pushing “P” on the hand-held controller. Repeat the process to weigh the next vehicle. The CPU is capable of storing 299

Figure 9 – Hand-held Controller Keypad

runs. The runs contained within the CPU can be cleared by pushing "C" on the hand-held controller at the end of any run. Caution: this will erase all runs stored in the CPU. If system "hangs" or "locks up" for any reason, simply turn the power off to the CPU cabinet and then return power. The system will reboot and be ready for use again. Previous runs will be stored on the hard disk.

It is expected that two people will operate the WIM system. One operator will input the vehicle ID numbers and operate the hand-held controller while the other operator will queue the vehicles, determine the vehicle ID number, and pass this number to the first operator.

V. Shutdown

To shutdown the system after operation with the intention of using the system again in the same location, simply turn the CPU cabinet off and press and hold the On/Off button of the hand-held controller until it powers down. All data will be saved and will be accessible once the system is restarted.

To shutdown the system with the intention of packaging and shipping the system, be sure that all needed data has been extracted from the CPU. Next press "C" on the hand-held unit to clear all runs, and then follow the shutdown instruction in the preceding paragraph.

VI. Packaging

To repackage the WIM system for shipping refer to figures 10 through 15 and follow the instructions below.

- To disconnect the cabling reverse the connection sequence and replace the dust covers on the sensor connectors.
- Stack the leveling pads onto the pallet
- Stack the tapered ramps onto the leveling pads
- Stack one transducer onto the leveling pads with cable end of the transducer facing the side of the pallet with the letter "A"
- Place two 2X4s onto this transducer to provide proper separation, then stack the next transducer (see figure 11)

- Insert wooden blocks to support the sides of the top transducer being careful not to place the wood on top of the black tape switches (see figures 11 and 12)
- Stack the CPU cabinet onto the transducer pads
- Construct the shipping frame by matching pieces with the same letter and using 3” screws
- Be sure to add plywood protector panel to cover the transducer cables (see figure 15)

Figure 10 - Components Stacked and Ready

Figure 11 – Components Stacked and Ready for Frame

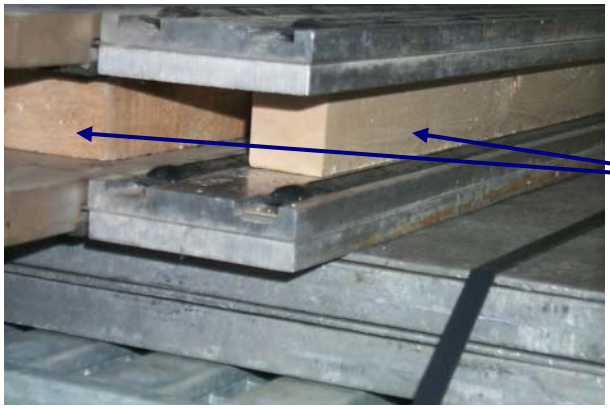


Figure 12 – Wooden Spacers to Prevent Damage to Tape Switches

Figure 13 – Wooden Spacers to Prevent Damage to Tape Switches

Figure 14 – Crated and Ready to Ship

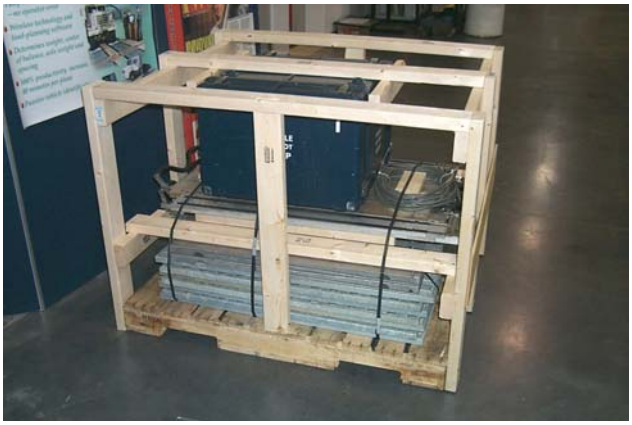


Figure 15 - Crated and Ready to Ship

Appendix A

Monitor Screen

The monitor screen is divided into five areas:

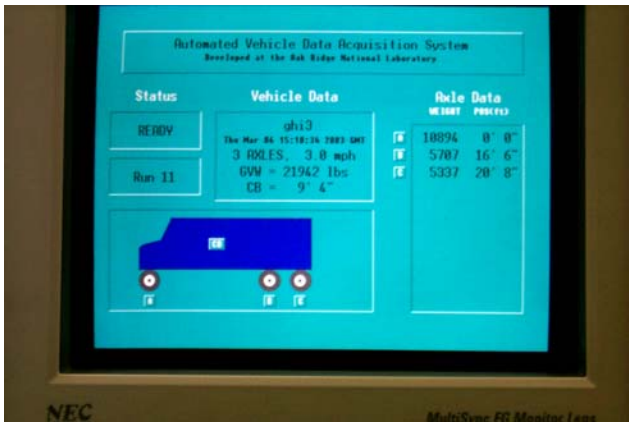
1) Status – Ready to weigh
Standby (waiting for a command)

2) Run Number – The software automatically assigns a run number for housekeeping purposes.

3) Vehicle Data – This box shows time, date, vehicle ID number, number of axles, speed, GVW, and center-of-balance.

4) Axle Data – This box shows the weight of each axle and the distance of each axle from the first axle.

5) Vehicle Graphic Box – This box shows a graphic of the vehicle with axle placement and CB.



Appendix B

Hand-held Controller Commands

A - Start weigh
< - Back up one run on display
> - Go forward on run on display
1 through 9 - Display corresponding axle info
P – Print
+ or - Toggles backlight on display
S – Displays detail on monitor