



ULTIMATE GUIDE TO VEHICLE WEIGHING SYSTEMS

For Chain of Responsibility Purposes

Diverseco
Can Do





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Introduction



On 1 October 2018, the new Chain of Responsibility (CoR) provisions associated with Heavy Vehicle National Law (HVNL) legislation HVNL came into effect. These will have far-reaching implications for the road transport industry and organisations with road transport supply chains.

Existing obligations have been reformulated as primary duties and any business or individual who is involved in the road transport supply chain now has a primary duty of care to ensure the safety of road transport operations, including operations outside of their direct control, within their supply chain.

In practical terms, the National Heavy Vehicle Regulator (NHVR) says this primary duty represents an obligation to eliminate or minimise potential harm or loss by doing all that is reasonably practicable to ensure safety.

Because the new CoR provisions focus on managing risk, all parties in the road transport supply chain must take a broader and more targeted risk assessment benchmarked against new industry codes of practice and develop tailored mitigating and remedial safety measures to discharge their primary duty of care.

This means that organisations can proactively reduce risks related to their transport tasks; rather than reacting when there's a possible breach of the law. It also means ensuring that supply chain activities are considered through risk assessments and systems to manage safety.

For these reasons, enforcement agencies, such as VicRoads, now have greater powers to investigate possible breaches of the Heavy Vehicle National Law.

To avoid penalties, that can include prison sentences in serious cases, all parties within the road transport supply chain must ensure that they have safety management systems in place - which can include vehicle weighing devices - to ensure heavy vehicle safety.

Considering that heavy goods vehicle (HGV) overloading and unequal load distribution are chief safety risks in any road transport operation - technical experts from DiverseCo have prepared this Guide to describe the mass management controls that road transport organisations companies can include in their safety regime to prevent breaches of CoR laws.

This guide is designed to help industry stakeholders within organisations operating with road transport supply chains to measure up to the new Chain of Responsibility mass management laws by providing:

- › **Insights** into the range of vehicle weighing devices at their disposal
- › **Information** about their relative features, functions and benefits, and
- › **Knowledge** of the conditions that the weighing devices are best suited to

Measuring up to the New Chain of Responsibility Laws

With new stringent CoR laws in effect, it is imperative that organisations review their safety management systems and mass management processes.

Vehicle weighing systems enable organisations to take the guesswork out of the safe, legal vehicle loading of HGVs in their road transport supply chain by enabling drivers to avoid overloading and ensure equal load distribution while maximising payloads.

To determine if a HGV is overloaded or that a load is unequally distributed, enforcement agencies' inspect, measure and sum axle group loads, rather than individual axles within the group.

An axle group can be any combination of single, twin, tri or quad axles. Depending how the axle group is constructed, errors can occur when weighing individual axles in an axle group because of load redistribution. This is why loadings in all data sheets related to heavy vehicles, show axle group weights not individual axle weights, and they are policed in this way.

Integrating vehicle weighing solutions into an organisation's safety management system will not only improve the safety of its road transport operations, but also enable it to realise a host of other benefits such as:

- › Meeting compliance requirements
- › Boosting operating efficiencies
- › Ensuring optimum allocation of resources
- › Sharing information with supply chain partners

While most readers will be familiar with weighbridges, which can be suitable for trade-use where the weight of product will determine a charge; most organisations will only require a system that will be used as a control point to measure axle group weights for safety and Chain of Responsibility compliance purposes.

The following static and dynamic weighing equipment can be used to obtain the axle weights of heavy goods vehicles for these purposes:

- 1 Weighbridges
- 2 Static Axle weighers
- 3 Low Profile Axle weighers
- 4 Weigh-In-Motion (WIM) Systems
- 5 Onboard Overload Control Systems
- 6 Wheel Weigh Pads

This Guide provides readers information about each device, and also the accessories and software systems that can transform these industrial weighing devices into fully fledged weighing systems that bring organisations myriad benefits beyond meeting compliance requirements.

Weighbridges

A weighbridge is an industrial weighing instrument that is used to reliably and accurately determine the gross weight of a vehicle and its axle group weights. It is usually mounted on a concrete surface, and has an electronic or digital monitor that displays the weight of the vehicle.

With a capacity of up to 300 tonnes or more, weighbridges are constructed from one or more platforms (also known as decks). For example, a 28m weighbridge could consist of four decks that are 4m, 6m, 8m and 10m. The sizes of the decks are aligned to the axle groups of the vehicle being weighed.

Weighbridges are available in a variety of configurations, including single and multiple deck. If a multi-deck weighbridge is in use, an operator drives the truck onto the weighbridge and then stops in the correct position to capture both the axle group weights and the gross vehicle mass. The advantage of this is that individual axle groups can be weighed both individually and simultaneously.

While a single deck weighbridge is ideal for gross mass vehicle measurements, a heavy goods vehicle may then need to be weighed in sections (depending on its size) using 'end and end' method to obtain axle group measurements. This means a truck must drive on one axle group at a time. To attain accurate weight measurement readings, the entire vehicle must be in the same plane i.e. level height during this process. Software can then be used to capture axle group readings, one group at a time.

Depending on site and operational requirements, weighbridges can be built above ground (or surface-mounted) with a lead-up ramp, or semi-pit or in-ground which allow the deck's weighing surface to be at ground level. The weighbridge decks can either be built from steel or concrete and are by nature extremely robust.

+ THE PROS

- › Weighbridges are the most accurate vehicle weighing system available, because they are capable of weighing all axle groups on the same plane and at the same time (depending on their size).
- › Multi-deck weighbridges instantly capture all axle group weights in one weighing, including the total weight of the vehicle. Therefore, they are well suited to high intensity operations when throughput is concentrated at certain times of the day.
- › Above ground weighbridges are well suited to leased, temporary sites or where portability is a pre-requisite, as they require the least amount of site preparation and foundation work prior to construction.

- THE CONS

- › Weighbridges require a relatively large footprint, even when this is for split weighing, which is an established method of weighing a truck and trailer separately

For example, a B-double heavy goods vehicle requires a 28m deck and a 28m level approach to ensure that the vehicle is in the same plane during the weighing process.
- › Given their accuracy and reliability, weighbridges are most expensive vehicle weighing system.
- › In some circumstances, the weighbridge must be long enough to hold all wheels of the longest vehicle to be weighed.

✓ Ideal Uses

Weighbridges are ideal for use in:

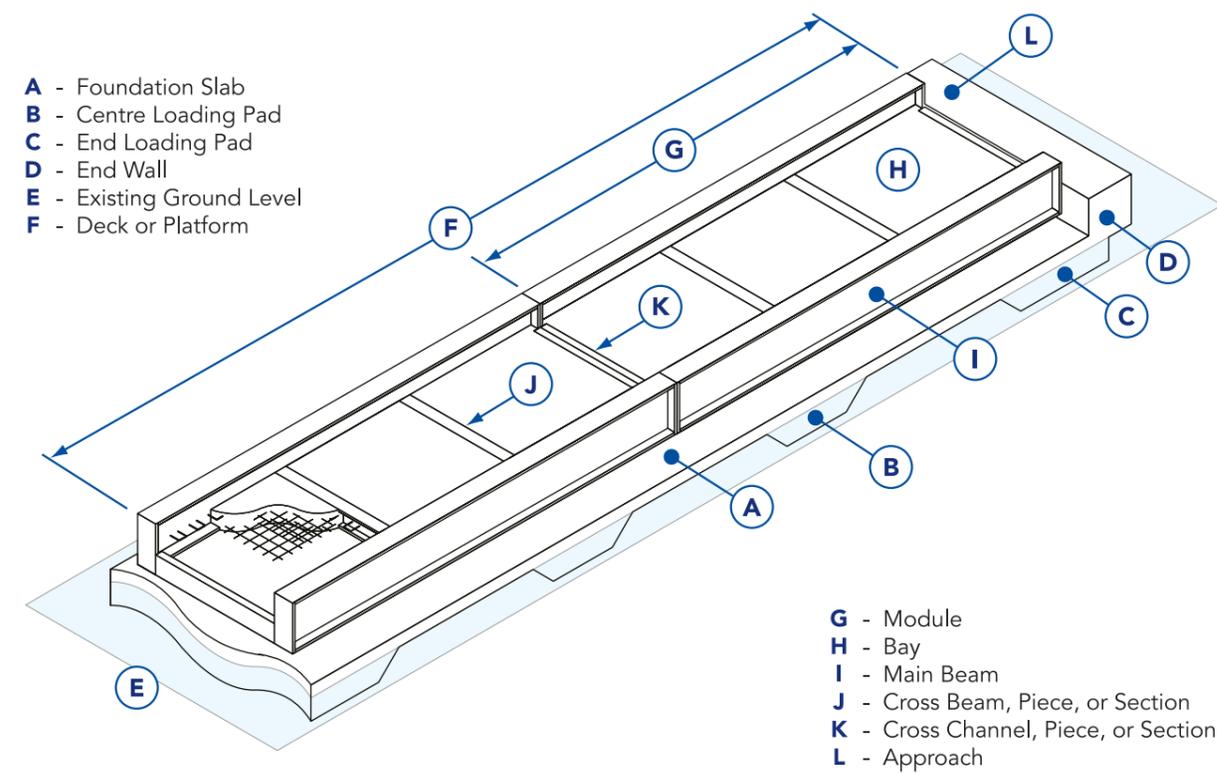
- › NMI Trade Approved purposes where invoices are raised based on the trucks payload weight, such as in bulk commodities, agricultural, quarrying and mining, and waste industries.
- › Weighing vehicles that need to be weighed while they are being loaded
- › Sites with restricted space where 'end and end' split weighing occurs.
- › High throughput operations





Designing a Weighbridge Station

Above Ground Weighbridge Isometric Diagram



In-ground Weighbridge

Static Axle Weighers

Designed to weigh individual axle groups, axle weighbridge decks are typically 4m long by 3m wide, and are installed in a pit so the deck is at ground level. The decks tend to be of a lower profile than a full-length weighbridge, requiring less excavation and foundation works.

To record weights for each axle group on a static axle weigher, the truck is driven across the weigher, stopping in the correct position to weigh each axle group. For example, to capture each axle group of a B-double HGV, the vehicle needs to stop in four positions.

As weighing accuracy is affected by the approach to and departure from the axle weigher, a flat and level approach and departure area are required. This enables the vehicle to remain in the same plane at any given time during the weighing process. Therefore, for weighing measurement accuracy the quality of the entry and exit approaches must be exceptional (to within ± 2 mm) for the entire length of the vehicle being weighed.



Axle Weigher

+ THE PROS

- › Provided the site is level, static axle weighers can be a relatively economical solution for Chain of Responsibility legislation requirements.
- › Much less site excavation is required when compared to a weighbridge.

- THE CONS

- › Cannot be used for NMI Trade Approved purposes
- › The time taken to weigh a complete vehicle is longer compared with using a weighbridge because the vehicle needs to stop in position for each axle group.
- › The quality of entry and exit approaches must be exceptional to ensure accuracy and reliability.
- › Additional concrete and materials may be required to construct these precision approaches
- › The accuracy of measurements are susceptible to conditions such as brakes being on or off, and air bags being on or off.
- › The weights cannot be summed together for trade measurement purposes.

✓ Ideal Uses

Static axle weighers are perfect for:

- › Weighing of all types of heavy goods vehicles in operations with moderate throughputs.

Weigh-in-Motion (WIM) Systems

Weighing-in-motion (WIM) systems can automatically capture and record the weight readings of each individual axle loading, and identify the Gross Vehicle Mass (GVM) of both the vehicle and its trailer while the vehicle is in motion.

Unlike static weighbridges or axle scales, WIM systems don't require vehicles to stop for weighing. Operators simply drive over the weighbridge steadily at a reduced speed of up to 5km per hour. This makes the weighing process more efficient, eliminating unnecessary delays and downtime.

WIM systems typically consist of a platform—measuring 730mm by 3,000mm—supported by four loadcells. A WIM system when correctly installed and calibrated will achieve +/- 2% accuracy per axle group. Much like a static axle weigher, the accuracy and reliability of a WIM system is highly dependent upon a level approach and departure, and vehicle behaviour. The level needs to be flat and consistent for a full truck length before and after the weigh platform.

+ THE PROS

- › The main benefit of a WIM system is that a vehicle does not need to stop and start for each axle group. This ensures:
- › Relatively fast traffic flows.
- › Faster weighing times when compared to a static axle weigher.
- › The weigher itself has a small footprint, making it ideal for small, busy and constricted sites.

- THE CONS

- › A vehicle must travel across the platform at a constant speed to ensure accuracy.
- › The quality of entry and exit approaches must be exceptional to ensure accuracy and reliability.
- › The additional concrete and materials required to construct these precision approaches can make WIM systems a less attractive option, particularly compared to a full-length weighbridge.
- › Drivers must be educated on how to use WIM systems properly.
- › Boom gates and other controls may be required to ensure the system is used correctly by drivers
- › WIM systems are not NMI Trade Approved.

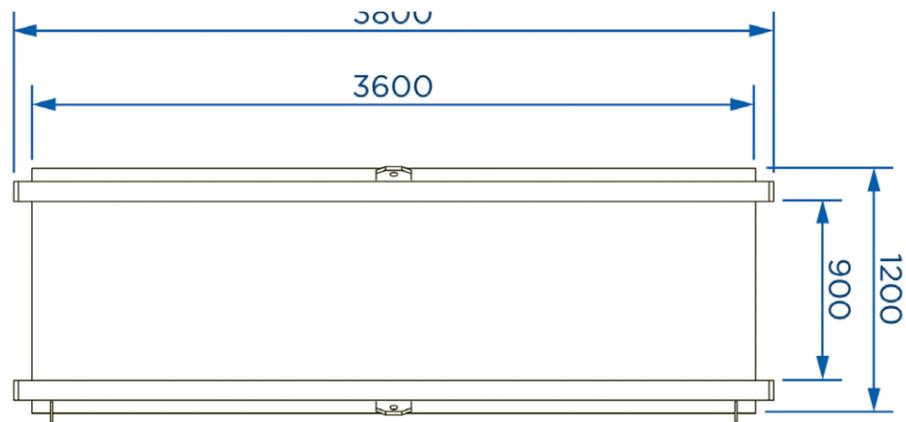
✓ Ideal Uses

WIM systems are well-suited for:

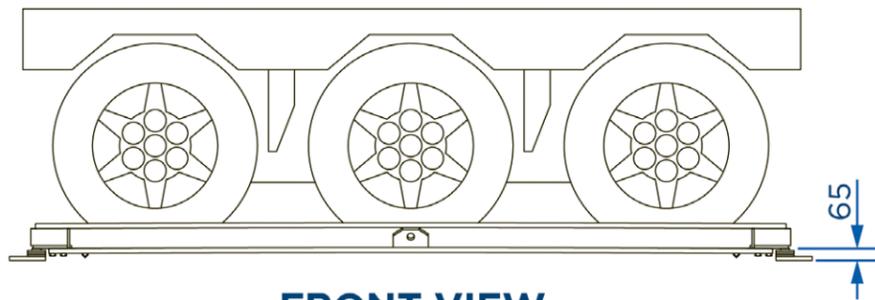
- › Use in high throughput sites, such as freight terminals and shipping ports, where vehicles must be weighed to ensure compliance with legal weight limits.
- › A whole range of industries, from transport, waste, and forestry, right through to demolition, excavation, marine and ports.

**Weigh-in-motion
system in action**

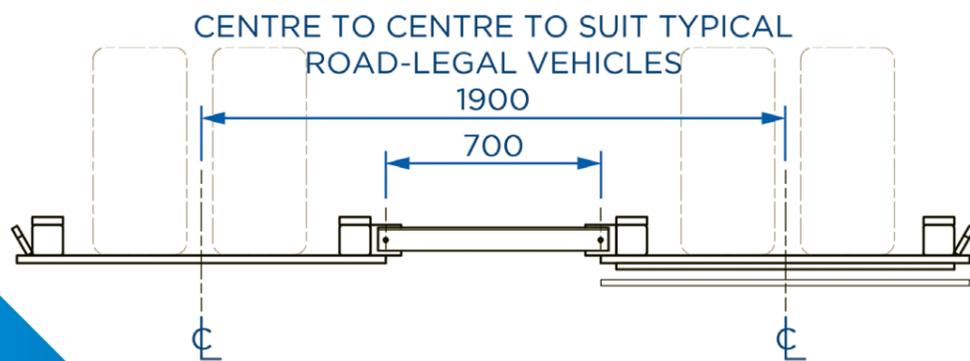




PLAN VIEW
SINGLE WEIGH PAD



FRONT VIEW
TRI-AXLE SHOWN



CROSS-SECTIONAL VIEW

LPAX
Drawings

Low Profile Axle Weighers (LPAX)

Specifically designed for weighing axle groups, Diverseco's low profile axle weighers (LPAX) are modular, lightweight, easily transportable and fully portable weighing devices with a 30 tonne capacity.

Installed as a stand-alone unit up to 65mm above ground, or in a 65mm shallow recess, weighing occurs on two 3.6m long tracks that enable the weight of each axle group to be captured efficiently. Because they sit almost flush with the ground, LPAX weighers provide highly accurate readings.

LPAX weighers are designed to be used on a flat concrete hardstand or on an area when the land has been suitably compacted.

The LPAX weighs about 1.25 tonnes per wheel track and can be moved with just a fork lift. For this reason, their portability is one of their major drawcards.

+ THE PROS

- LPAX weighers are modular, lightweight, easily transportable and fully portable, without compromising reliability or accuracy.
- Least amount of siteworks and site disruption for installation and use
- Full axle groups can be weighed quickly.
- A relatively economical solution to meet Chain of Responsibility compliance requirements.

- THE CONS

- Cannot be used for NMI Trade Approved purposes
- The time taken to weigh a complete vehicle is longer compared with using a weighbridge because the vehicle needs to stop in position for each axle group.
- The accuracy of measurements is susceptible to conditions such as brakes being on or off, and air bags being on or off.

✓ Ideal Uses

LPAX weighers are suited to:

- Sites that are leased, temporary sites or road building projects where the weighing device needs to be moved close to work area.
- Weighing of all types of heavy goods vehicles in operations with moderate throughputs.
- Facilities where loading or vehicular movement occurs in many locations, suiting the portable nature of the LPAX.



LPAX with Truck



Onboard Weighing Systems

As the name suggests, onboard overload and payload control systems are installed directly on board heavy goods vehicles and trailers. They are usually fitted to a vehicle's chassis, suspension system, or to the loading equipment attached to the vehicle itself. This means that onboard systems can be used quite effectively for both static and dynamic weighing applications.

Onboard systems are available in many different configurations, from simple overload detection / warning devices, through to full legal for trade solutions.

Onboard systems can be installed on most spring and air suspension vehicles, as well as trailers up to 50 tonnes, including semi-trailers, B-doubles and road trains. Overload and payload control systems function by monitoring spring deflection or air suspension for single steer and multiple dual and tri-axle groups.

Easy to fit on new and some existing vehicles, most onboard system utilise solid state electronics, which means little wear and tear, however harsh the conditions; these systems are proven to be extremely reliable and almost maintenance free.

+ THE PROS

- Offering monitoring of both total load and load distribution, onboard weighing systems can help prevent overloading.
- Quick and easy to install on a wide range of vehicle types, sizes and configurations.
- Very little driver input required-the system operates automatically.
- Suitable for use on vehicles with mechanical suspension, air suspension or a combination of the two.
- Some onboard weighing systems are suited for NMI Trade Approved applications.

- THE CONS

- Onboard overload do not provide accurate weight readings until the suspension system nears full spring deflection, as they are to alert drivers that the vehicle is overloaded, rather than display payload weight.
- Most overload weighing systems are not trade approved.

✓ Ideal Uses

Onboard weighing systems are perfect for:

- Use operations where freight is collected from various sites; as opposed to weighing at a single point of origin.



Indicator for TruckWeigh Overload Control System

Wheel Weigh Pads

Wheel weigh pads (also known as axle weigh or wheel pad scales) are portable scales designed to weigh individual wheels and axles, and so can help ensure compliance with axle group legal load limits.

They are light-weight, low-profile, compact and self-contained scales constructed of aluminium. This enables them to be easily transported in the boot of a vehicle and carried by the average person.

Wheel weigh pads are primarily used to maximise legal payloads and reduce overload stress on equipment. They have a weighing capacity of up to 40,000lbs with an accuracy of $\pm 1\%$.

Digital electronics provide fast, accurate, easy to read data in the weigh indicator. They also feature fully integrated RFX wireless weighing technology that allows for six or more wheel weigh pads to connected wirelessly. This enables both individual wheel weights and combined axle groups to be captured in the same weighing.



+ THE PROS

- Fully portable and easily transported.
- Rugged, durable design that can endure accidental tyre overrun at all points, including the digital display area.

- THE CONS

- The accuracy of wheel weigher is dependent on having all wheels level and in the same plane to avoid inadvertent weight transfer to other axle groups.
- The relatively long time taken to weigh all axle groups; in the event that multiple wheel weigh pads are not being utilised at the same time.

✓ Ideal Uses

Wheel weighers are well suited to:

- Use operations where freight is collected from various sites; as opposed to weighing at a single point of origin.
- Weighing a wide range of vehicles including: caravans, tractors, cranes, earthmoving equipment and trucks.
- Use in remote locations, as they are solar powered.

Low profile wheel weigh pads in use



Selecting the Right Vehicle Weighing System

There are a number of important factors that you need to consider when selecting a vehicle weighing system, from maximum weights and sizes through to its suitability to your site and your operation.

Ensure that you ask the following questions and that they are answered to your full satisfaction before signing on the dotted line:

- Can the weighing equipment be custom designed and is it suited to site and operational requirements? Such as:
 - Will the weighing equipment be used for trade purposes?
 - What is the largest HGV that will be weighed, (anticipating future needs).
 - Does the scale need to accommodate traffic flows from more than one direction?
 - If there enough space for trucks to easily enter and leave the scale?
 - Is there a waiting area so that trucks queuing to be weighed don't stop traffic on the roadway?
 - Is the site level, with adequate load-bearing capacity?
 - Does the site offer adequate drainage?
 - Does the location offer room to expand by adding another scale if future requirements grow
- Is the equipment manufactured to stringent, superior Australian Quality Standards, and so suited to the Australian duty cycle and Australian HGV fleets? If not, this could easily lead to metal fatigue and weld fractures on the beams, which significantly reduce the equipment's working life.
- If required, does the weighing system meet the National Measure Institute's (NMI) legal-for-trade weighing requirements?
- Are you buying direct from the weighbridge manufacturer? Or from a third-party reseller? If it's the latter, does the seller have the requisite expertise to quickly find and rectify faults?
- Does the supplier stock replacement parts, and have a local service centre?
- Can your weighing device be transformed, using accessories and software, into 'intelligent' weighing system that delivers a raft of benefits, such as automating processes and collecting data?
- Can your supplier modify your existing single deck weighbridge to capture axle group weights?
- Does the weighing equipment come complete with a comprehensive warranty?
- Does the weighbridge offer flexible power supply options, including battery power, solar power, and mains power?

Vehicle Weighing Accessories & Software

All the aforementioned, weighing devices can be connected to accessories and fully programmable weighing terminals that come complete with custom weighing functionality, data management capabilities and process controls that streamline the management of vehicle weighing operations. Today, most of this software can be easily configured and ranges from out-of-the-box entry-level packages for small sites, right through to bespoke, multisite software solutions.

This ease and flexibility of data management and transfer allows for maximum use of the collected data. This enables organisations to take control of mass management processes and incorporate this data into their safety management system, by automatically:

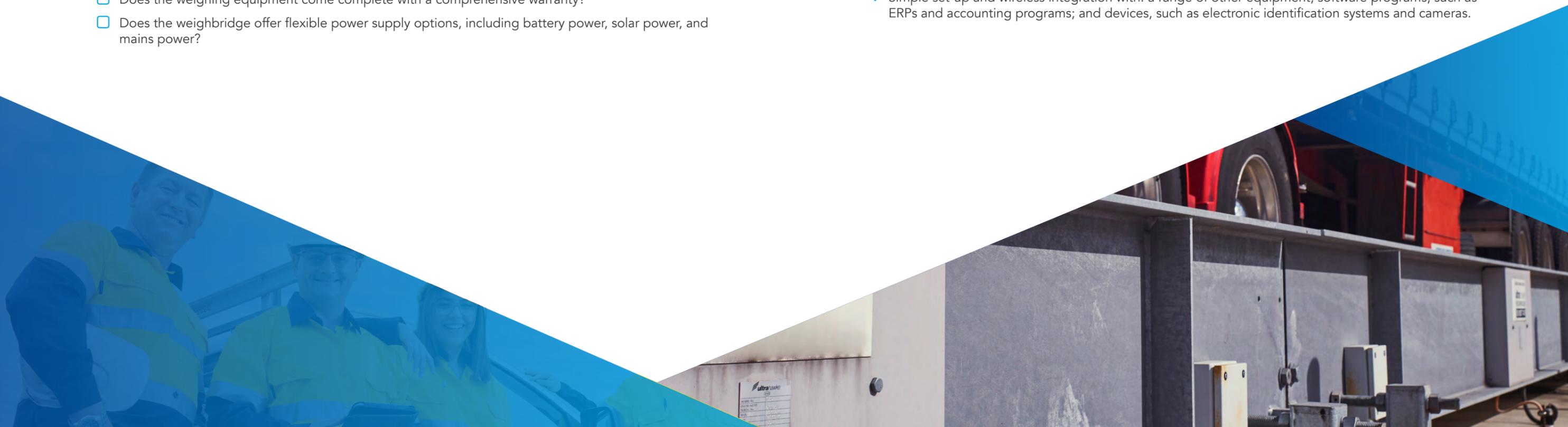
- providing truck classification information
- comparing the measured axle weights with pre-entered legal maximum limits
- signalling the operator of any over load breaches
- recording (in tamper-proof memory) any overload breaches
- providing a date stamped paper ticket record of all axle group weights and the total vehicle gross weight
- recording all transactions, and operating alarms, boom gates, sliding gates, warning sirens, and flashing lights to warn/prevent overloaded vehicles from leaving the site, and more.

Furthermore, the IT enablers can provide users a wealth of information that informs decision making process, and includes data such as:

- Number of vehicles processed through a site each day
- Volume (on an hourly, daily or weekly basis)
- Vehicle turnaround time and revenue (by customer and sector)
- Product types and weights
- Profitability and resourcing
- Customer history reports for compliance reporting purposes

Designed to increase operational performance and profits, vehicle weighing terminals and software, as supplied by DiverseCo offers:

- A complete suite of detailed, accurate, configurable reports and data
- User-friendly interfaces
- Simple set-up and wireless integration with: a range of other equipment; software programs, such as ERPs and accounting programs; and devices, such as electronic identification systems and cameras.



About Us

Originally evolving from the industrial weighing sector, DiverseCo has built on its capabilities to become one of Australia's leading integrated measurement and automation solutions provider to a broad range of industries.

Since establishment in 1992, our company has grown through mergers and acquisitions to become the international company it is today, with offices and operations in every Australian mainland state and internationally in New Zealand and Singapore.

As one of Australasia's leading measurement and automation solutions providers, we aim to provide our customers superior value by combining an intimate understanding of their needs with our problem-solving expertise and innovative weighing, dimensioning, packaging, inspection and robotics automation technologies. Our team has a long, strong history of converting our customers' challenges into new capabilities.

For these reasons, we are driven by: the continuous improvement of our people, processes and operations; heavy investment in training and technology; and continuous innovation, which includes revitalisation of its operations by changing the scope of its business and competitive approach.

With a global customer base and long-standing relationships with prominent international suppliers, Diverseco has won many business and entrepreneurial awards and prides itself on the contribution it makes to society through a range of charitable programs



Testing a Driver Control Station





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