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Belt Scales

Belt scale systems are used to monitor material flow rate at a variety of worksites including mines, quarries, bulk material blending and processing facilities, and truck, rail or barge load-out sites. They are one of the most efficient systems to move and weigh bulk material.

Due to the difficult nature of weighing bulk material on an in-motion conveyor, belt scales are manufactured with varying degrees of expected accuracy. Accuracy errors can range from as high as 2% on single-idler belt scales to as low as 0.25% on multi-idler belt scales. It is essential to discuss your accuracy requirements with a belt scale distributor before purchasing a system to ensure it meets your application needs.

Parts of a Belt Scale

Belt scale systems generally include a weigh frame, load cells, a speed sensor and an integrator.



WEIGH FRAMES

Weigh frames, sometimes called scale carriages, are the weighing structure of a belt scale and usually consist of load cells and attachment points for either rollers or idlers, which support the conveyor belt. Weigh frames must be designed to minimize deflection and the impact of off-center loading while providing frictionless pivot points. These design elements help ensure system load cells are registering only material weight as it is carried by the conveyor.



SPEED SENSORS

Speed sensors measure the speed and distance conveyor belts are travelling as they pass over weigh frames and idlers. Conveyor belt speed is an essential component to material totalizing, making the speed sensor and belt travel pick-up placement condition critical to accuracy. Errors in speed measurement can occur due to slips between the belt travel pick-up and conveyor belt, material buildup on the belt travel pick-up and belt conveyor speed variations caused by changing tension.

LOAD CELLS

As conveyors carry material, weight is measured by load cells, which convert the force into an electrical signal that can be processed and displayed by an integrator. Strain gauge load cells are the most commonly used load cells in belt scale systems because they have minimal deflection from no-load to full-load conditions. Additionally, strain gauge load cells have excellent temperature stability, resulting in negligible zero drift and errors due to temperature changes—critical for systems typically used in outdoor applications.



INTEGRATOR

An integrator, sometimes called a weight indicator or process controller, processes the load and speed data, which is displayed as pounds or kilograms per hour and total weight, usually displayed in tons. Integrators should be designed to withstand temperature changes and harsh weather if it is installed outside with the belt scale and not in an office.

Integrators can also be connected to PLCs to control weight-based processes or peripheral equipment such as computers and printers for weight data management.

SECTION 2



WIND SHIELDS

Outdoor belt scale applications will need wind shields or wind breaks installed around the weigh frames. Wind and weather can negatively impact conveyor belt travel and scale accuracy. Enclosing the belt scale weigh frames can help prevent snow or ice buildup while ensuring the conveyor belt remains in proper contact with weigh frame idlers.





SECTION
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Belt Scale Installation and Application Considerations

A belt scale expert can help determine the best system for each operation, but these guidelines can help you prepare for the conversation.

Conveyor Belt and Idler Design

The belt scale and 20 feet (6 meters) of conveyor belt on either side of the scale should be protected from wind and weather to prevent interference with weight processing. To reduce dangerous deflection and protect sensitive weighing equipment, conveyor frames should be isolated from mechanical equipment such as bins, feeders and crushers.

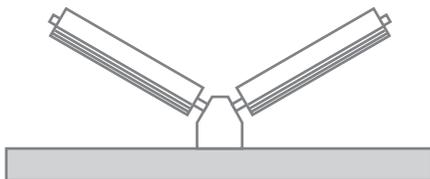
Conveyor support is essential to minimizing deflection and maintaining accurate weighments. Load cells and weigh frames are manufactured to minimize deflection, but stringer deflection must also be accounted for. Stringers supporting the scale idlers should have rigid welds connecting them with rigid support in the stringer itself. Connections between the other conveyor stringers don't need to be rigidly welded, allowing for expansion and compression due to temperature fluctuations.

Conveyor Types

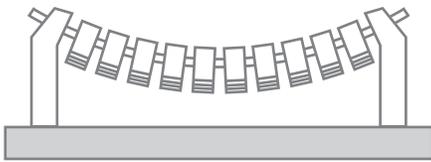
Rope or cable conveyors cannot be used with conveyor belt scales because they offer no rigid support. If a belt scale is used on a rope conveyor, there must be a rigid conveyor section installed that is long enough to support the entire scale system.

Belt scales should not be used with cable-supported conveyors, including stacking conveyors. When the angle of incline or elevation changes between scale calibrations, scale accuracy is greatly reduced.

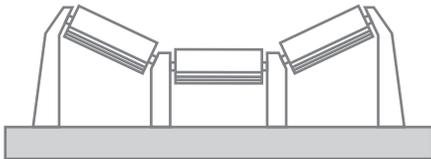
Cleated conveyor belts cannot be paired with belt scales because cleats prevent the conveyor belt from being in proper contact with scale area idlers, impairing belt tracking. The belt must touch scale idlers at all times to ensure an accurate no-load or zero measure. This ensures when the belt is loaded, full material weight is accurately measured.



V Idler



Cable or Rope Idler

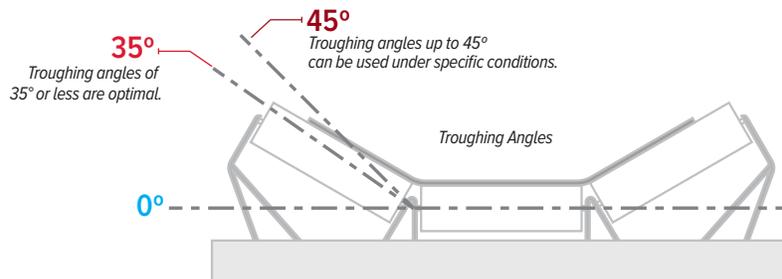


Standard Idler (preferred)

Idler Types

The type of idler used in the scale area is essential—avoid V-type and rope or cable idlers. Offset idlers may work for some conveyor carriages, but standard idlers are preferred for most belt scale types. Additionally, the belt should never extend over the edge of the idlers and if the conveyor is longer than 30 feet (9 meters), it should have a gravity take-up.

Conveyor idlers in the scale area must be uniform with the same troughing angle and rating. Top grade idlers will work for most belt scale applications, as long as the dimensions and troughing angles are the same. Troughing angles should be 35° or less to minimize the catenary effect on the conveyor belt, though troughing angles up to 45° can be used under specific conditions. Idler alignment should be verified during installation as scale idler alignment is essential for accurate weights.





Location & Loading

Scale Location

Scale location on the conveyor belt can greatly influence accuracy of the belt scale system. The scale should be installed where tension variations are minimal, typically near the tail section of the conveyor but far enough forward so the scale isn't impacted by skirtboards.

Scale Loading

While most belt scale systems can operate accurately if material is loaded inconsistently, it's important that material loading is as uniform as possible. The conveyor should be loaded at the same point, not at multiple points along the conveyor belt. Any dispensing hoppers should have adjustable gates to ensure material is loaded uniformly and belt tension is as consistent as possible.

Belt scale systems use material loading and conveyor belt speed to process total material weight. If the speed and slope of the conveyor belt is too great, it can cause material slippage, resulting in inaccurate weights.



Tripper in use at aggregate site.

Curves & Trippers

Convex curves and concave curves have different challenges, and therefore have different spacing/location requirements with a belt scale.

Convex Curves

Conveyors without curves are best for belt scale integration because this design maintains better tension. However, if it is unavoidable, a convex curve can't be between the material loading point and the scale. The scale should be installed so any convex curves are at least 20 feet (6 meters) or five idler spaces, whichever is greater, after the scale idlers.

Concave Curves

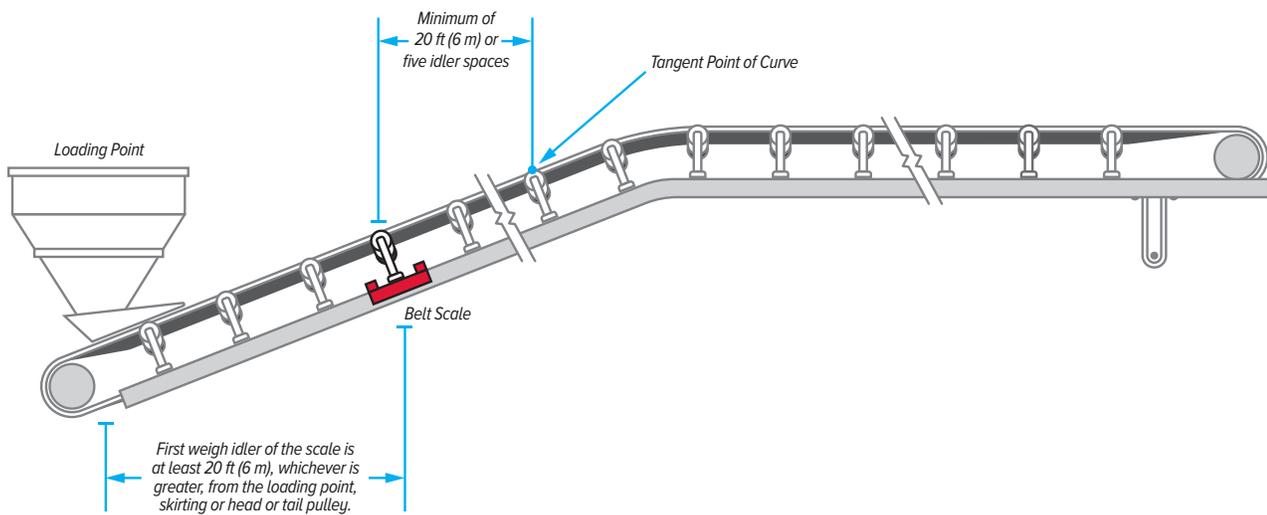
Concave curves present more of a challenge for belt scale installations. Whether a concave curve is before or after the scale, the scale must be installed so the conveyor belt is in contact with all idlers for at least 20 feet (6 meters) or five idler spaces, whichever is greater, before and after the scale. Additionally, the scale must be installed so that at least 40 feet (12 meters) are between the scale and the start of a concave curve.

Trippers

For any application where accuracy is essential, a belt scale should not be used on a conveyor with a moveable tripper. If a belt scale must be installed on a conveyor with a tripper, the distance requirements between the scale and tripper are the same as a concave curve—at least 40 feet (12 meters) between the scale and the start of a fully retracted tripper.

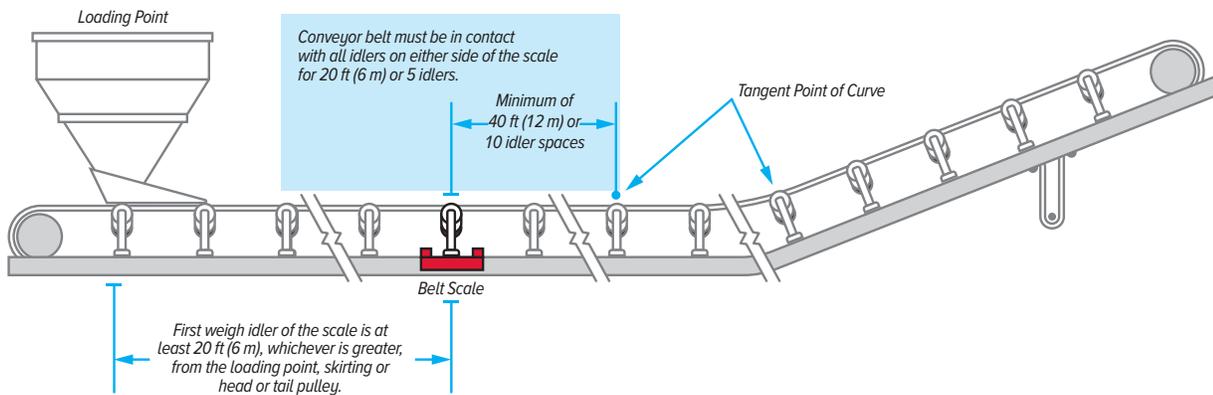
Convex Curve Diagram

Distance between scale and tangent point of curve



Concave Curve Diagram

Distance between scale and tangent point of curve





SECTION
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Belt Scale Maintenance

Regardless of the accuracy of a specific belt scale design, these weighing systems will not perform accurately without proper routine maintenance.

Following a routine maintenance schedule for the entire material handling system help ensure your scale is providing accurate weighments. Remember, the weighing system isn't just the belt scale weigh frames and load cells, it includes the entire conveyor belt. Therefore, any changes to the conveyor can impact scale performance.

Scale Calibration

After initial installation, you should check your belt scale calibration weekly and verify the zero span every other day to ensure accuracy. As you record the results of each calibration, you can begin to lengthen the amount of time between calibrations.

During calibration, most belt scale integrators will provide a deviation number, or the error change between the previous calibration and the most recent calibration. The deviation is essential for determining calibration frequency because it allows you to track the accuracy of your belt scale.

In addition to the required accuracy and changes in conveyor condition, large temperature changes and conveyor system maintenance should also be considered when determining if additional calibration is necessary.

Changes in temperature can impact the length of a conveyor belt, also changing the system tension and accuracy of the scale. Using gravity take-ups for tension and setting belt tension as loose as possible without causing belt slippage can minimize the effects of temperature changes, though additional calibrations are still recommended.

Adjusting the tracking or gravity take-ups, replacing or lubricating idlers, and changing the belt speed can also impact the scale's accuracy. Always perform a system calibration after any conveyor maintenance to ensure accurate weight readings.

General Maintenance Routine

Having a planned maintenance schedule and inspection procedure can help ensure each part of your material handling and weighing system is functioning properly.

Every day, clear the scale weigh frames of rocks, dust and material buildup, including snow or ice. Address any film or material buildup on the belt with belt scrapers or by performing a zero calibration to compensate. Ensure any skirtboards or covers are not placing any additional force on the scale and clear them of any material buildup when the conveyor belt is not running. Material can get stuck between the belt and skirtboards when the conveyor belt is running, causing significant scale errors.

One or two times annually, lubricate the scale idlers and perform a zero calibration afterwards. Use caution to not over-grease, as too much grease can change the scale's tare weight and put it out of calibration.

Ensure scale idlers remain properly aligned to provide a straight path for the belt as it travels over the scale. The conveyor belt must be trained to run true to the center line of the of scale idlers while it is empty or fully loaded.

Because belt tension is essential to scale accuracy, the gravity take-up area must be kept clear of spillage to ensure the carriage can move freely in its guides while the conveyor belt is running. Material loading must be carefully monitored to ensure the flow rate doesn't exceed 125% of the instrument range or drop so low as to cause inaccurate weighments.

Gravity take-up area must be kept clear of spillage to ensure the carriage can move freely in its guides while the conveyor belt is running.





SECTION
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Belt Scales from Rice Lake Weighing Systems

Rice Lake Weighing Systems offers a broad selection of durable and accurate belt scales. With several models to choose from, Rice Lake Master™ belt scales provide a solution for nearly every application, including food, recycling, chemical, steel, animal feed, compost production, sand and gravel quarries, harbor logistics operations and mining.

882D PERFORMANCE SERIES

BELT SCALE INTEGRATOR

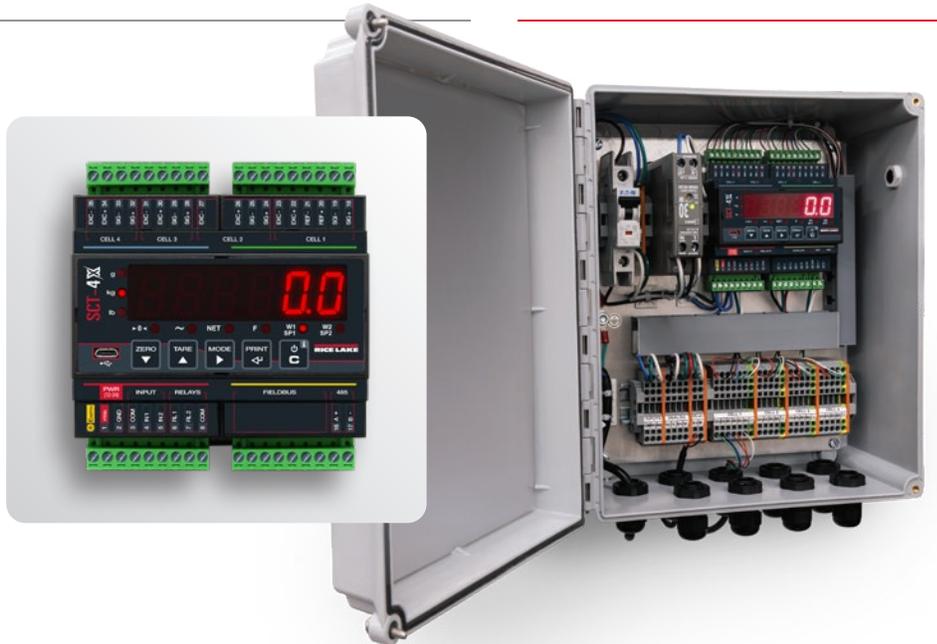
Specifically designed for belt scales, the 882D belt scale integrator delivers required data in a compact package. Featuring iRite™ software programmability, it can be customized to control product dosing or manage metering. The 882D's backlit display makes viewing rate, speed and time convenient in almost any lighting condition. The 882D is also protected from the weather in an IP66 stainless steel enclosure, making it ideal for use in harsh environments.



SCT-4XD

BELT SCALE DIGITIZER

The SCT-4XD belt scale integrator can manage up to four load cell inputs, providing diagnostic information needed to prevent load cell failure. It can be easily mounted via DIN rail to an existing panel, simplifying installation. The SCT-4XD can be paired with the 1280 Enterprise™ Series indicator for an easy-to-use operator interface. Four load cell inputs come standard with each unit, providing diagnostic information needed to stay ahead of load cell failure.

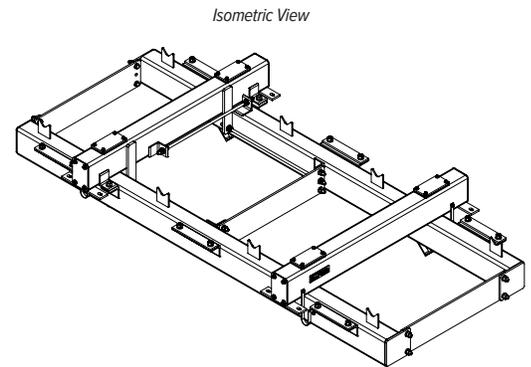


1280 ENTERPRISE SERIES

PROGRAMMABLE CONTROLLER WITH COLOR TOUCHSCREEN

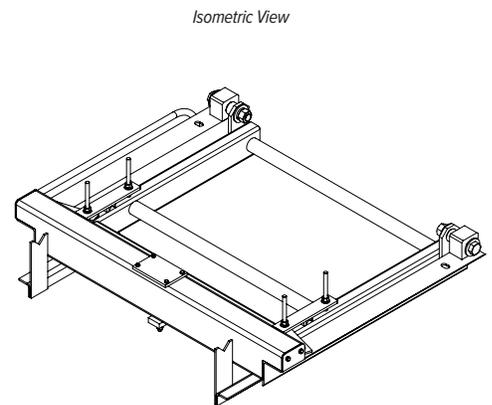
14X WEIGH FRAME

The 14X Master belt scale weigh frame has two, three or four idlers on an inner frame supported by four load cells. This creates an incredibly accurate belt scale qualified for high capacities and belt speeds. The 14X is often used in mining and aggregate applications. The frame is custom made using conveyor belt specifications, making it suitable for different conveyor belt models.



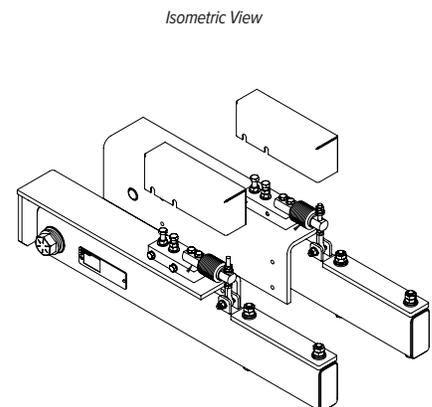
211 WEIGH FRAME

The 211 Master belt scale weigh frame consists of an inner frame mounted to one end of the scale with two friction-free pivots. The load cell is located on the opposite end with the idler mounted on the inner frame. The friction-free pivots absorb tensile stress in a horizontal direction, creating a very solid weigh frame well-suited for heavy-duty applications.

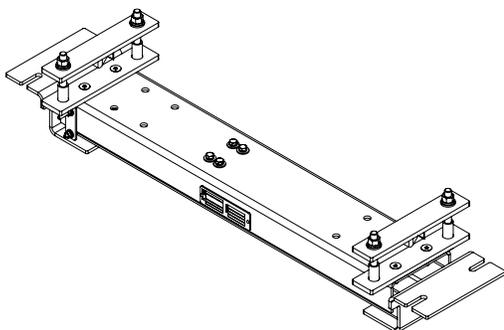


221DB WEIGH FRAME

The 221DB Master belt scale weigh frame consists of two arms equipped with a pivot and a load cell mounted to side supports of the conveyor belt. The idler, or weighing roller, is mounted on top of the frame arms. The 221DB provides simple assembly and accessibility for service. Suitable for most belt widths and capacities, the 221DB requires no customization and is a versatile solution for many applications.



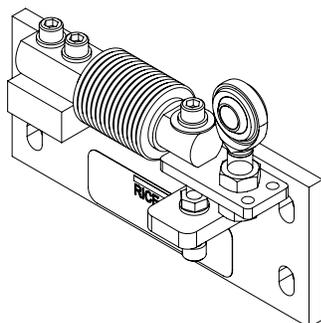
Isometric View



311 WEIGH FRAME

Consisting of an idler placed on a simple load cell beam, the 311 Master belt scale weigh frame is a cost-effective solution. Suitable for belt widths up to 60 inches (1,500 millimeters) and belt speeds up to 6 feet (2 meters) per second, the 311 belt scale is often used in lighter capacity applications with broader tolerance needs to simply monitor material flow.

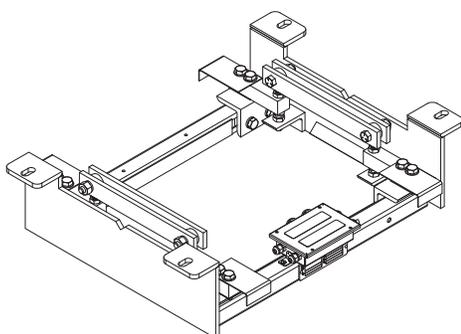
Isometric View



421 WEIGH FRAME

The 421 Master belt scale weigh frame is specifically designed for high-volume, low-density applications where belt load and speed are moderate. Ideal for flat conveyor belt, the 421 features two BM11 bending beam, hermetically sealed load cells mounted to adjusting plates on the outside of the conveyor stringers to create a stable base. The 421 Master belt scale is also available for hazardous and potentially explosive areas.

Isometric View



BCi WEIGH FRAME

The BCi belt scale weigh frame is a durable solution for process control and load-out applications. It can process up to 10,000 tons per hour with a maximum belt speed of 1,200 feet per minute. The BCi weigh frame has a system accuracy of 1% with a single idler and 0.5% with a two idler system.



Why Rice Lake?

With a proven history of providing high-quality weighing products, Rice Lake Weighing Systems was founded on the principle of excellent customer service and offers 24/7/365 support with facilities and distributors around the world. Rice Lake also offers a one-year product warranty against faulty workmanship and defective materials.

**Contact Rice Lake Weighing Systems
at 800-472-6703 or prodinfo@ricelake.com to discuss
your application requirements.**



HEADQUARTERS

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