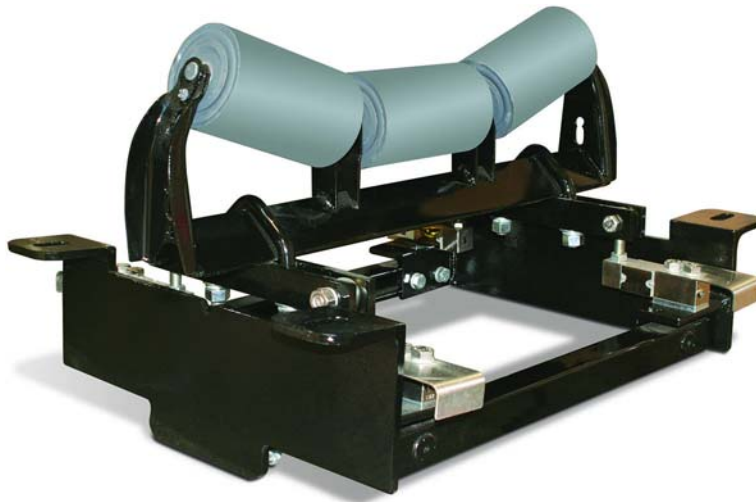


Belt Scale

Reference Guide



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Contents

1.0	Introduction	1
1.1	Safety	1
1.2	Overview	2
1.3	Belt Conveyor Scale System Components	2
2.0	Reference Material	3
2.1	Application Brief	3
2.1.1	Load Cell Size	3
2.1.2	Belt Speed	3
2.1.3	Idler Spacing	4
2.1.4	Belt Splicing	4
2.2	Selecting a Mounting Location	4
2.2.1	Tension	5
2.2.2	Uniform Belt Loading	5
2.2.3	Single Load Point on Belt	5
2.2.4	Material Slippage	5
2.2.5	Convex Curves	5
2.2.6	Concave Curves	5
2.2.7	Trippers	6
2.2.8	Troughing Angle	7
2.3	Incompatible Applications for a Belt Scale Installation	7
3.0	Maintenance	8
3.1	Maintenance Checkpoints	8
3.1.1	Cleaning	8
3.1.2	Lubrication	8
3.1.3	Belt Training	8
3.1.4	Belt Tension	8
3.1.5	Belt Loading	8
3.1.6	Material Sticking to the Belt	8
3.1.7	Skirtboards and Covers	8
3.2	Belt Scale Troubleshooting Tips	9
3.2.1	Calibration Shifts	9
3.2.2	Zero Calibration Shifts	9
3.2.3	Span Calibration Shifts	10
3.2.4	Field Wiring	10



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1.0 Introduction

This manual supplies information common to most belt scale applications.



This manual can be viewed and downloaded from the Rice Lake Weighing Systems website at www.ricelake.com

Warranty information can be found on the website at www.ricelake.com/warranties

1.1 Safety

Safety Signal Definitions:



Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Includes hazards that are exposed when guards are removed.



Indicates a potentially hazardous situation that, if not avoided, could result in serious injury or death. Includes hazards that are exposed when guards are removed.



Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury.



Indicates information about procedures that, if not observed, could result in damage to equipment or corruption to and loss of data.

General Safety



Do not operate or work on this equipment unless this manual has been read and all instructions are understood. Failure to follow the instructions or heed the warnings could result in injury or death. Contact any Rice Lake Weighing Systems dealer for replacement manuals.



Failure to heed could result in serious injury or death.

Some procedures described in this manual require work inside the indicator enclosure. These procedures are to be performed by qualified service personnel only.

Take all necessary safety precautions when installing the scale carriage including wearing safety shoes, protective eye wear, and using the proper tools.

Do not allow minors (children) or inexperienced persons to operate this unit.

Do not operate without all shields and guards in place.

Do not jump on the scale.

Do not use for purposes other than weight taking.

Do not place fingers into slots or possible pinch points.

Do not use any load bearing component that is worn beyond 5% of the original dimension.

Do not use this product if any of the components are cracked.

Do not exceed the rated load limit of the unit.

Do not make alterations or modifications to the unit.

Do not remove or obscure warning labels.

Do not use near water.

Keep hands, feet and loose clothing away from moving parts.



1.2 Overview

A belt conveyor scale continuously measures bulk material as it moves along a conveyor. The system requires two general parameters to operate:

- Weight of the material being moved along the conveyor belt.
- Speed at which the material moves along the conveyor belt.

The weight of the material on the belt is determined by weighing a section of the conveyor belt loaded with material and subtracting the average weight of the unloaded belt. The speed at which the material is moving is determined by measuring the speed of an idler or wheel in contact with the conveyor belt. The weight and speed are combined to give a running total and a rate of flow for the material. Optimum operation of the scale system requires the components to be installed correctly, periodically calibrated, and properly maintained.

Typical applications where belt conveyor scales are used:

- Mining
- Quarries
- Bulk material blending
- Truck/barge/rail loading
- Process control applications

In addition, a belt conveyor scale can compute the total mass of the material conveyed over a given period of time and while it is in motion.

1.3 Belt Conveyor Scale System Components

The main components of a basic belt conveyor scale are:

- Scale carriage
- Load cells
- Belt travel pickup speed sensor (not shown)
- Electronic integrator

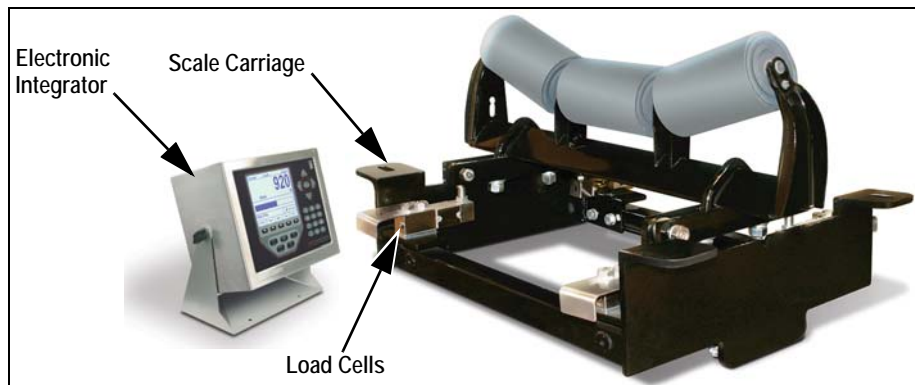


Figure 1-1. Component Parts of a Belt Conveyor Scale System

2.0 Reference Material

2.1 Application Brief

There are four factors used to determine a suitable belt scale application on a given conveyor.

- Load cell size
- Belt speed
- Idler spacing
- Belt splicing

2.1.1 Load Cell Size

The capacity of the belt scale is rated on the maximum continuous load that can be carried across the weigh idler. The capacity of the conveyor should be known prior to determining the components of the scale system. The load cells should be sized to operate across a loading range with a marginal safety factor. The minimum net loading should be greater than 10% of the rated capacity and the maximum loading should be less than 65%. The load applied to the loadcell can be calculated using formula:

Net load = (conveyor capacity / belt speed) x idler spacing

Gross load = net load + (idler weight + belt weight + mounting hardware)

Examples:

Net load = (50,000 lb per minute / 400' per minute) x 4' spacing

Net load = (125 lb per foot) x 4' spacing

Net Load = 500 lb

Gross load = 500 lb + (175 lb idler + 48 lb belt + 24 lb hardware)

Gross Load = 747 lb

Net Load > 10% of total load cell capacity

(4) x 500 lb load cells x 10% = 200 lb

500 lb > 200 lb (500 lb load cells are okay)

(4) x 1000 lb load cells x 10% = 400 lb

500 lb > 400 lb (500 lb load cells are okay)

(4) x 2000 lb load cells x 10% = 800 lb

500 lb > 800 lb (2000 lb load cells are too large)

Gross Load < 65% of total load cell capacity

(4) x 250 lb load cells x 65% = 650 lb

747 lb > 650 lb (250 lb load cells are too small)

(4) x 500 lb load cells x 65% = 1300 lb

747 lb < 1300 lb (500 lb load cells are okay)

(4) x 1000 lb load cells x 65% = 2600 lb

747 lb < 2600 lb (1000 lb load cells are okay)

The example listed would require 500 lb or 1000 lb load cells.

2.1.2 Belt Speed

The belt speed is defined as the maximum velocity of the unloaded conveyor belt. The belt speed can be variable, but for sizing requirements the maximum speed is required.

2.1.3 Idler Spacing

The spacing between idlers should conform to the recommendations of the idler manufacturer and the Conveyor Equipment Manufacturer's Association specifications. A general rule is that the idler supports the belt half the distance from the previous idler to half the distance to the following idler as shown in Figure 2-1.

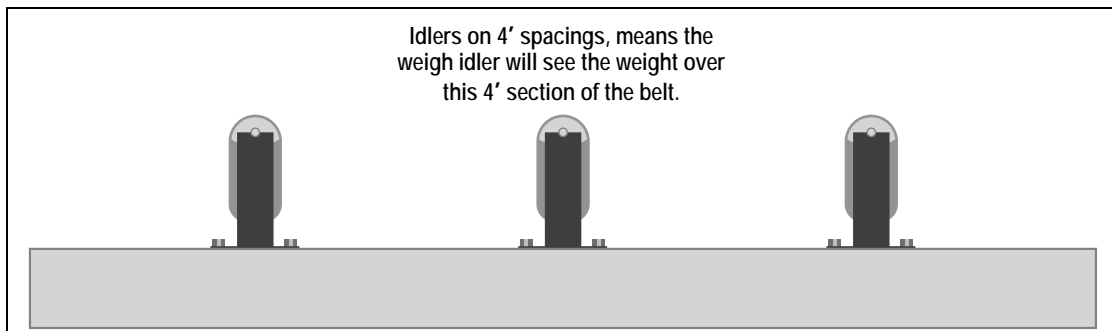


Figure 2-1. Idler Spacing Example

The number of weigh idlers required to accurately weigh the material being conveyed is determined by the velocity of the conveyor belt. The scale born time of the material should be greater than 400 mSec. If the belt speed multiplied by the idler spacing is less than 400 mSec, the idler spacing must be increased or multiple weigh idlers must be used. Scale born time can be calculated using the formula:

$$\text{Scale Time} = (\text{Idler Spacing} / \text{Belt Speed})$$

Example: $\text{Scale Time} = (4 \text{ feet} / 8.33 \text{ fps}) = 480 \text{ mSec}$

2.1.4 Belt Splicing

Belt splices also have a contributing factor in limiting the belt scale's capacity. Mechanical belt splices can shock load and damage load cells on high speed conveyors. Vulcanized splices are preferred for proper scale operation.

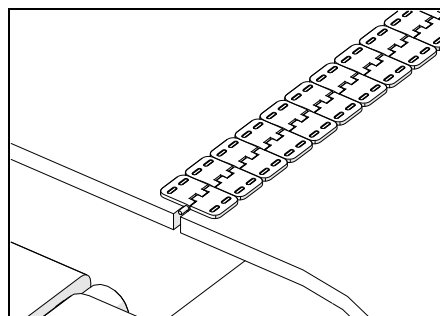


Figure 2-2. Mechanical Belt Splicing Example

2.2 Selecting a Mounting Location

It is important to select the right mounting location for the scale carriage along the conveyor structure and the location of the speed sensor. Several factors must be taken into consideration when selecting a mounting location and will determine the overall long-term and short-term accuracy expected. These factors include:

- Tension
- Uniform belt loading
- Single load point on belt
- Material slippage
- Convex curves
- Concave curves
- Trippers
- Speed sensor mounting location
- Electronic wiring location
- Speed wheel
- Troughing angle

2.2.1 Tension

The transfer of weight along the conveyor belt can be greatly affected by belt tension. By locating the scale carriage in an area of the conveyor with the **least amount of tension**, the scale will be more accurate and achieve better performance. An ideal location to mount the scale carriage is near a tail section of the conveyor, but forward enough to not be influenced by infeed skirts boards, etc. [Figure 2-3](#) illustrates the proper belt tension.

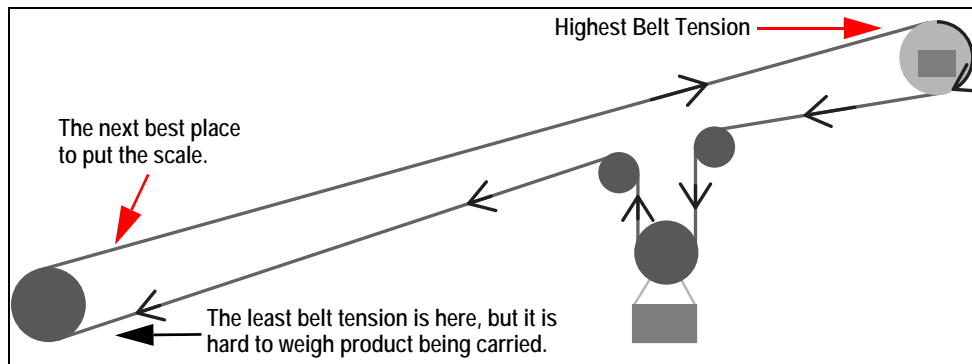


Figure 2-3. Proper Belt Tension Example

2.2.2 Uniform Belt Loading

The belt loading should be as uniform as possible to prevent unequal shifts in material. Hoppers should be equipped with depth limiting gates or other flow control devices such as a feeder to minimize surges or feed variations.

2.2.3 Single Load Point on Belt

On high accuracy installations, the conveyor should be loaded at one consistent point. This assures constant belt tension at the scale during all loading conditions.

2.2.4 Material Slippage

The belt scale system processes belt loading and belt travel to derive an accurate weight. Product speed must be equal to the belt speed at the scale. The conveyor speed and slope should not exceed that at which material slippage occurs. Typically this is less than a 20% pitch for most materials.

2.2.5 Convex Curves

Conveyors having convex curves should be avoided or the scale should be located in a section of the conveyor not affected by the curve.

Convex curves are permissible at a distance of 20 feet or a minimum of five idler spaces beyond the scale area idlers.

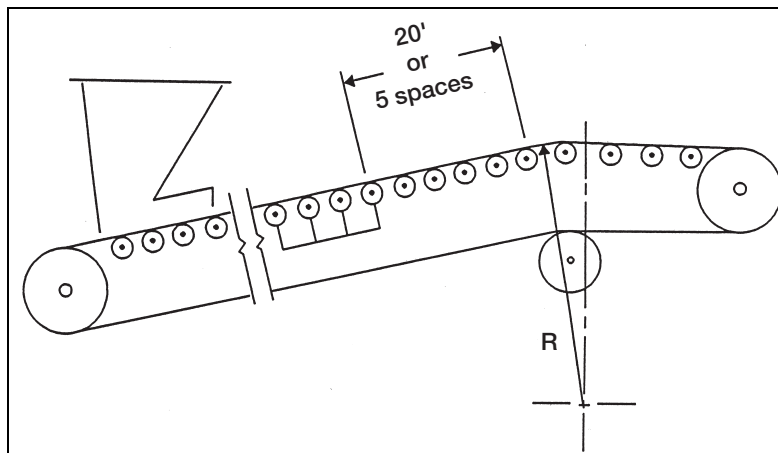


Figure 2-4. Convex Curved Conveyor

2.2.6 Concave Curves

Conveyors having concave curves should be avoided or the scale should be located in a section of the conveyor not affected by the curve. If there is a concave curve, the belt must remain in contact with the idler rollers at all times for at least 20' (6 m).

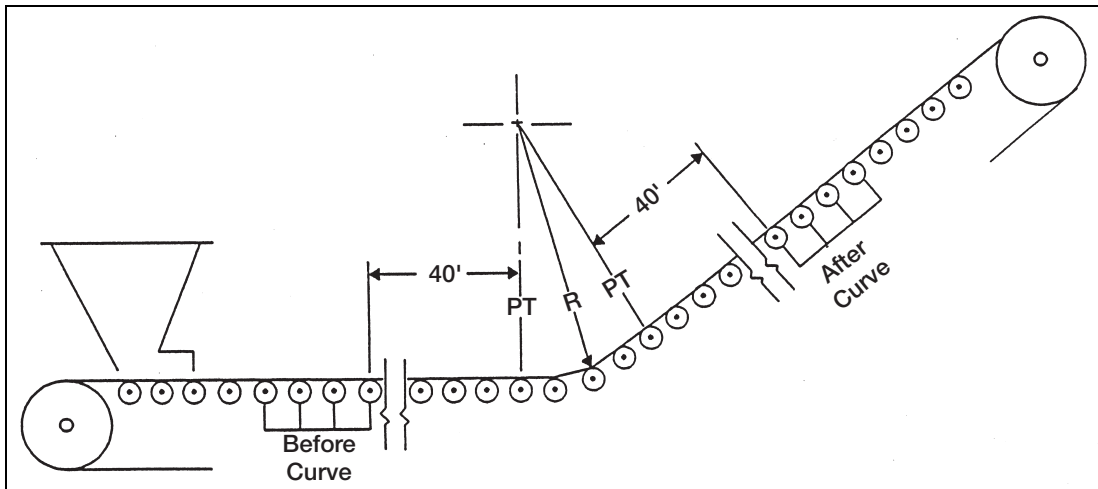


Figure 2-5. Concave Curved Conveyor

2.2.7 Trippers

Tripper belts, mechanical sweep samplers, training idlers, feed points, skirt boards and other device affecting belt tension should be located away from the scale carriage.

If the scale must be installed on a conveyor with a tripper, the same rules apply as for an installation in a concave conveyor.

Table 2-1 contains basic guidelines for minimum distances and applies to both horizontal and incline conveyors.

Type of Conveyor	Distance from Scale Carriage
End of skirt boards or feed point	15' or 4 idler spaces whichever is greater
Training idler or sweep sampler	30' or 8 idler spaces, whichever is greater
Tripper or concave curve	40' from the first idler affected by the curve
Convex curve or head pulley	20' or 5 idler spaces

Table 2-1. Distance Points from Conveyor to Scale Carriage

2.2.8 Troughing Angle

Troughing angles of 35° or less are preferred for all high accuracy installations. Troughing angles of 45° are acceptable under certain conditions.

Using idlers with steep troughing angles can cause many problems. The beam or catenary effect of the belt becomes more pronounced as the troughing increases and the effect of idler misalignment is amplified.

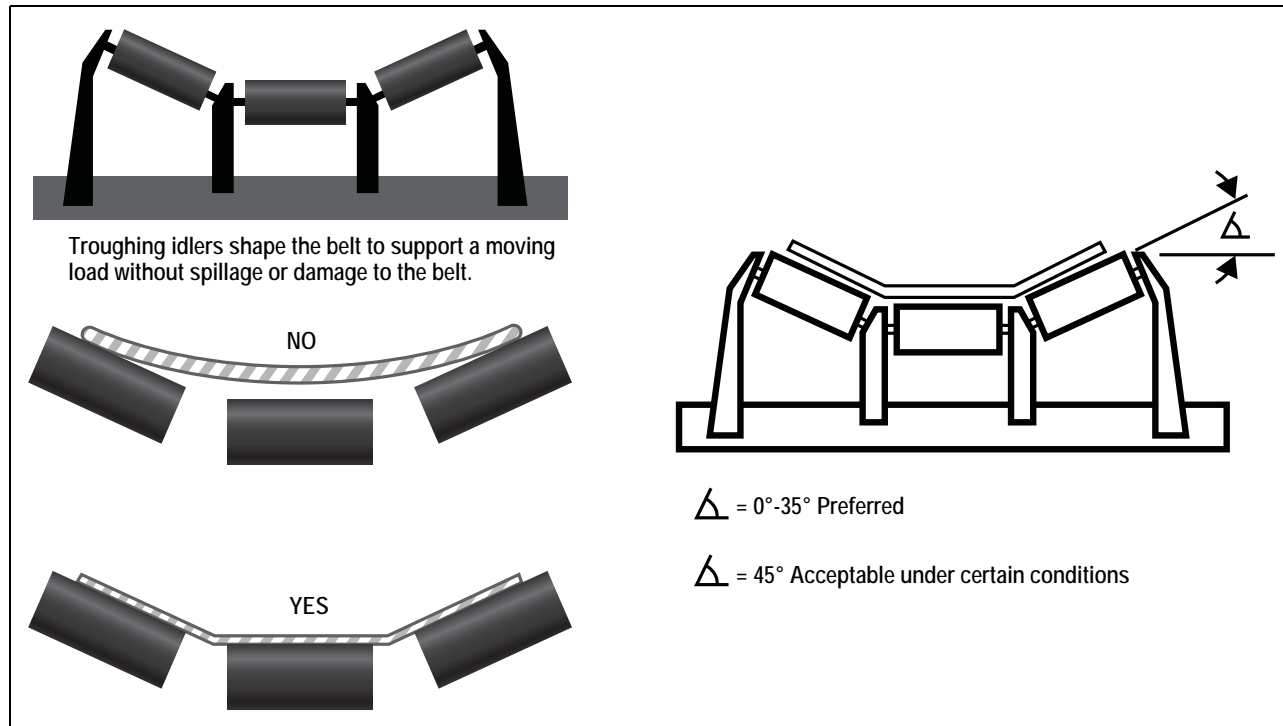


Figure 2-6. Troughing Angle Examples

2.3 Incompatible Applications for a Belt Scale Installation

The following are instances where a belt scale installation would not be the best solution:

- Conveyors with multiple loading points
- Conveyors with convex or concave curves
- Conveyors with different stringer members in troughing rolls
- Conveyors that do not receive periodic inspections and housekeeping
- Conveyors where there is no facility to conduct a simulated test
- Conveyors used in cold weather and not installed in a heated conveyor gallery
- Tripper conveyors
- Radial stacking conveyors
- Applications where the belt scale results are compared with a marine draft survey
- Applications where the belt scale weighment is subject to certification but the conveyor does not meet Handbook 44 requirements
- Applications where plant personnel are unwilling or unable to perform routine conveyor maintenance
- Conveyors with more than 2-ply belting
- Conveyors installed outdoors, but are not equipped with a cover over the carry belt

3.0 Maintenance

Maintenance information in this section covers maintaining and troubleshooting the weigh frame. Should a problem require technical assistance, contact Rice Lake Weighing Systems.



Note *Have the scale model number and serial number available when calling for assistance.*

3.1 Maintenance Checkpoints

Establish a routine inspection procedure including the belt conveyor scale and the entire material handling system. Note any changes in the scale function and report them to the individual or department responsible for the scales' performance.

3.1.1 Cleaning

Keep the scale area clean of rocks, dust and material build-up.

3.1.2 Lubrication

The weigh idlers must be greased one to two times yearly. Overloading the weigh idlers with grease can change the tare weight and place the scale out of calibration. A zero calibration is necessary after greasing.

3.1.3 Belt Training

The belt must be trained to run true to the center line of the idlers in the area of the scale while running empty, as well as under loaded conditions. Where this cannot be accomplished due to off-center loading, the loading must be modified. Where a belt does not train while empty but does train while loaded, it is necessary to train the belt over the scale area at least during the calibration checks.

3.1.4 Belt Tension

It is important the conveyor conditions remain constant at all times. Therefore, gravity-type take-ups are recommended on all conveyors where belt scales are installed. Conveyors not having a constant tension device require calibration whenever the belt tension changes and the take-up is readjusted.

3.1.5 Belt Loading

Extreme loading conditions causing the flow rate of material to be above 125% of the instrument range must be avoided. Load capacity above this amount can't be measured. Belt loading must be adjusted to stay within the instrument range. In addition, very low flow rates, with respect to full scale range, can produce low accuracy.

3.1.6 Material Sticking to the Belt

Material can form a film on the belt which is carried continually around the belt and is never discharged. This often occurs when handling wet, fine material. Belt scrapers may correct this condition. The zero must be adjusted if the film cannot be removed. Change in the build-up of the film adhering to the belt requires further adjustment.

3.1.7 Skirtboards and Covers

Skirtboards should not be placed closer to the weigh idlers than the +3 or -3 idler. If skirts or covers are necessary in the weighing area, they must not place external forces on the scale. Even if the skirts are clear of the belt under *no load* conditions, material can jam or slide between the boards and the belt when the conveyor is operating. Errors of several percent can be expected where such conditions exist.



Belt Scale Maintenance Checklist						
Item	Daily	Weekly	Monthly	Quarterly	Annually	Description
Scale area - debris	x					Clean scale area; determine cause of debris and take steps to remedy
Condition of idler rolls		x				Inspect idlers for wear and damage; replace rolls and bearings as necessary
Belt scraper		x				Adjust or replace blades if worn
Belt condition		x				Visual inspections for cuts, tears, or worn edges
Belt take-up			x			Inspect for free travel, (bearings, belts, etc)
Speed pulley			x			Inspect for wear, material build-up, belt wrap; check bearings
Speed sensor coupling			x			Inspect for tightness, wobble and corrosion
Load cell offset				x		No load output must be within 1% of rated maximum
Load cell balance				x		Multiple load cell scales must be balanced to within 1 mV
Static weight condition				x		Check for corrosion, location and clearances
Resolution time				x		Verify time for 1 belt revolution at maximum speed
Zero reference number				x		Compare zero number with reference and maximum change is 2% per year
Audit trail				x		Review scale history
Line voltage				x		Measure hot and neutral, hot to ground, neutral to ground; correct as necessary
Alignment					x	Complete per manual
Excitation					x	Verify value and stability
Belt length					x	Measure and verify; perform acquire test duration if changes noted
Check rods					x	Inspect check rods; rods must be straight, spherical washers without corrosion
Spherical washers					x	Inspect for corrosion, pitting, etc; replace if necessary
Material factors					x	Verify with weighed load test

Table 3-1. Maintenance Checklist

3.2 Belt Scale Troubleshooting Tips

The following sections cover basic troubleshooting tips for the belt scale. If the integrator in-motion belt scale fails to operate properly during or after performing set up and calibration, it is recommended to perform the procedure again and, if the problem still persists, follow the troubleshooting procedures listed in the following sections.

3.2.1 Calibration Shifts

Frequent calibration shifts should be isolated to zero shifts or span shifts.

3.2.2 Zero Calibration Shifts

Zero calibration shifts are normally associated with the conveying system. When a zero shift occurs, the span shifts by a like number of TPH, this then appears as a span shift.

Common causes of zero shifts:

- Material buildup on the carriage/weighbridge assembly
- Rocks lodged in the carriage/weighbridge
- Conveyor belt tracking
- Non-uniform conveyor training
- Conveyor belt belting stretch due to material temperature variations
- Trouble in the electronic measuring components
- Severely overloaded load cell

3.2.3 Span Calibration Shifts

Span calibration shifts are normally associated with the electronic measuring of components of the system, with the exception of conveyor belt tension. A span shift is present if both points change by the same percentage TPH.

Common cause of span calibration shifts:

- Change in conveyor belting tension
- Speed sensor roll build-up and/or slipping
- Conveyor scale alignment
- Severely overloaded load cell
- Trouble in electronic measuring components

3.2.4 Field Wiring

Check the electrical portion of the scale if a problem with the wiring of the belt scale is suspected.

- Check for proper interconnections between the components of the system. All the wiring must be as specified on the installation drawings.
- Check all wiring and connections for continuity, shorts and grounds using an ohmmeter.
- Loose connections, poor solder joints, shorted or broken wires and unspecified grounds in wiring cause erratic readings and shifts in weight readings.
- Check all cable shields to ensure grounding is made at only the locations specified in the installation drawings.





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