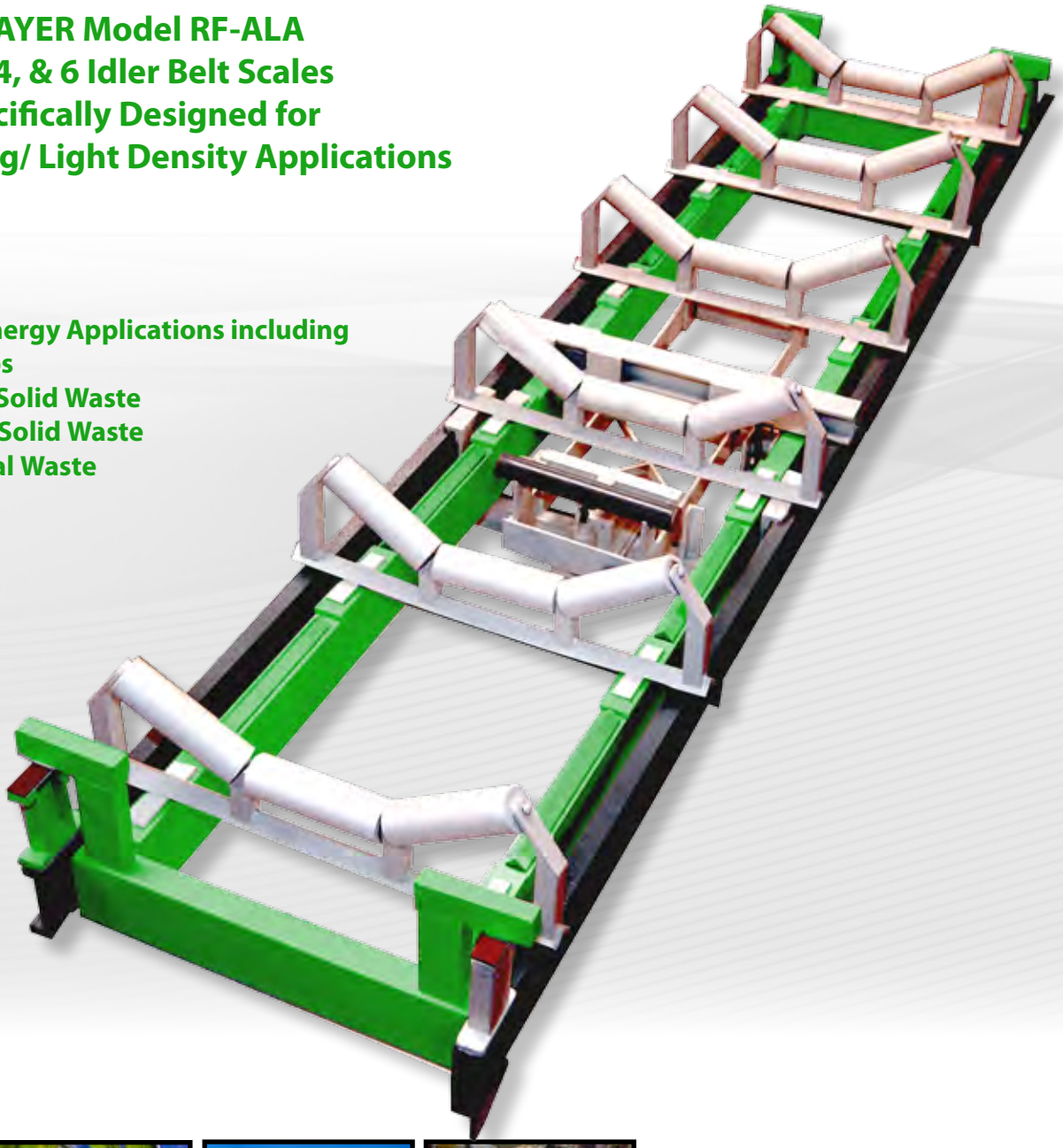
THAYER SCALE

PROCESS MEASUREMENT & CONTROL EQUIPMENT

THAYER Model RF-ALA
2, 3, 4, & 6 Idler Belt Scales
Specifically Designed for
Light Loading/ Light Density Applications



Biomass Energy Applications including

- **Wood Chips**
- **Municipal Solid Waste**
- **Industrial Solid Waste**
- **Agricultural Waste**

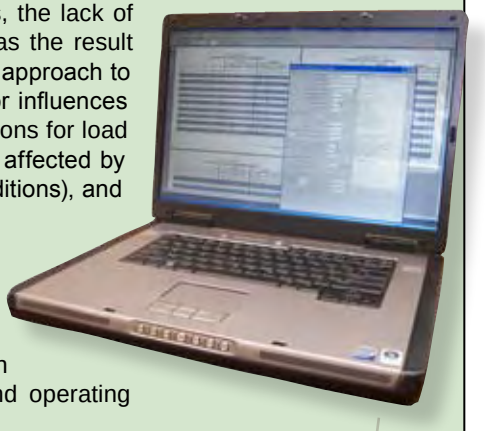
- ***EXTREMELY ACCURATE & RELIABLE***
- ***OPERATOR FRIENDLY***
- ***ROBUST***
- ***STATE-OF-THE-ART ELECTRONICS***
- ***FORCE MEASUREMENT SUSPENSION SYSTEM***

Superior Performance for Light Load Applications

THAYER'S Light Loading Belt Scales were specifically designed for high accuracy (1/10 to 1/2% typical) inventory control and throughput totalization of light scale loading applications such as Biomass, wood chips, saw dust, tobacco and land refuse. THAYER'S Belt Scale weigh bridge features exclusive rocking flexure suspension in the approach and Approach/retreat configurations. Measurement sensitivity is high, deflection is low, and the single load cell is isolated from the error-inducing effects of extraneous lateral forces, off-center loading, foundation distortion, inclination hold-back forces, and high sporadic shocks and overloads. Tare load is mass counterbalanced to create superior signal -to-noise ratio in weight sensing, orders of magnitude better than belt scale designs supporting full tare load on the load sensor.

THAYER Applications Program

THAYER is the only belt scale manufacturer that analyzes the customer's conveyor and application data to predict "real-world" performance. The computer program essentially tailors each component of the scale and conveyor to maximize the performance of the complete system based on the specific requirements of the application.



We consider the parameter variations that are normally experienced in conveyor installations, the lack of dimensional precision of the conveyor components and installation imperfections occurring as the result of both the initial set up and the subsequent conveyor maintenance activities, the most logical approach to designing and installing high accuracy belt weighing equipment is to design for minimum error influences in every phase of the project. This involves conveyor analysis work to seek out preferred locations for load and speed measurements within a conveyor, suspension system configurations that are least affected by conveyor influences, particularly alignment factors (load deflection vs. installed alignment conditions), and many other factors.

Major factors include: conveyor design, scale suspension design, location of load and speed sensors in relation to both conveyor terminal equipment and loading points, installed alignment conditions, duration and constancy of loading cycle, condition of rolling conveyor elements, the uniformity and stiffness of the belt itself, condition and size of take-up apparatus, the precision with which the system can be routinely calibrated, adherence to a calibration schedule and operating environment.

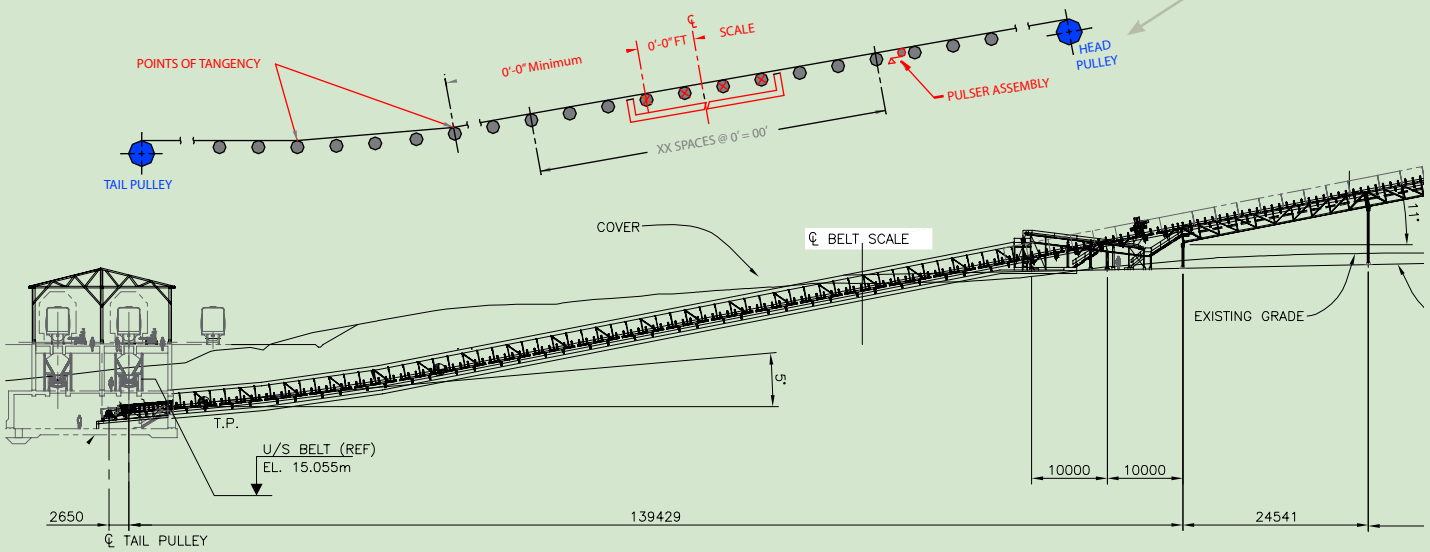
Actual "bias error" (offset between THAYER totalized weight and check scale weight) and "as-found error" (random error, i.e. repeatability) can be calculated for a given conveyor application using Thayer's belt scale performance math model.

This unique program was developed by THAYER, and is based on many years of experience in the field of high accuracy continuous weighing. The objective of the program is quite simple: To provide a means of producing a high performance Belt Scale installation.

$$P_i = nQ_iL\cos\varnothing + \frac{2t_i d_i}{L} = \frac{8EId_i}{L3} - \frac{nWL\,(T_i - T_c)\cos\varnothing}{EA} - \frac{nQ_iL(T_i - T_j)\cos\varnothing}{EA}$$

or C

= (mat. load or test load) + (tension misalign) + (stiffness misalign) - (belt stretch load) - (belt stretch speed)



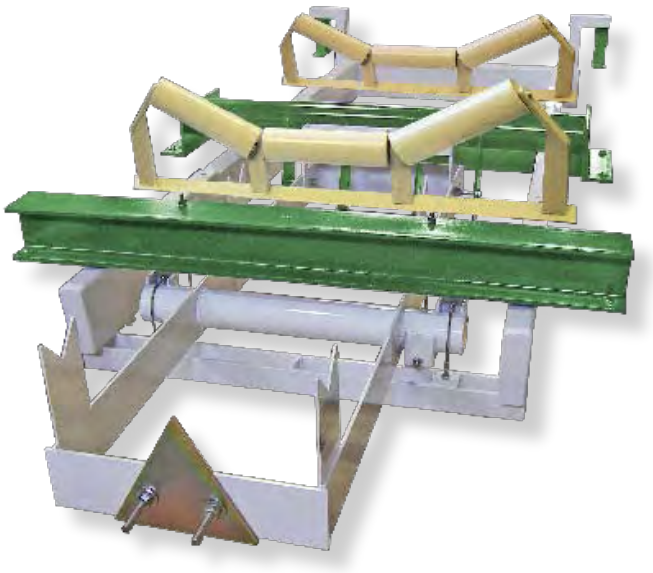
Thayer's Light Loading Belt Scales are highly advanced and extremely robust weight sensing technology based on the marriage of the weighbridge, weight transducer (load cell), embedded temperature sensing and proprietary linearizing and temperature compensating control control algorithms.

WEIGH BRIDGE

One of the most important components of a conveyor scale system is the design of the weigh bridge itself. Regardless of the type of load cell used, a belt scale will not be able to weigh lightly loaded material and maintain its calibration for long if certain design features are not in place.

Secondary Lever

Thayer employs a secondary lever system, even though it cost more to do so, because it permits the following:



1. We can add mass (weight) to counterbalance the dead load (idler support frame, idlers, belts) and by using a secondary lever, we do not load down the suspension pivot.

2. The scale provides for complete mass counter-balancing of the dead load (idlers and belt) of the conveyor permitting the load sensor to react only to the net material load.

3. By positioning the load cell correctly, relative to the secondary lever we can match load cell size to the net loading. Only in this way can any capacity scale be supplied to the same high accuracy standards.

4. The resulting increased lever ratio of the secondary lever reduces idler deflection, providing additional immunity to errors associated with belt tension.

5. The secondary lever system utilizes stainless steel aircraft cables as flexural elements to transmit and FOCUS pure tension forces to the load cell. The cables, being non-extendable, but laterally yieldable connecting links, permit the lever to align itself under conditions of varying stringer distortion. This is a most significant feature. A belt scale must use the conveyor stringers as its mounting base. These stringers not only deflect under varying conveyor loads, but may also rotate (or twist). A suspension system having the least possible structural redundancy is therefore essential.

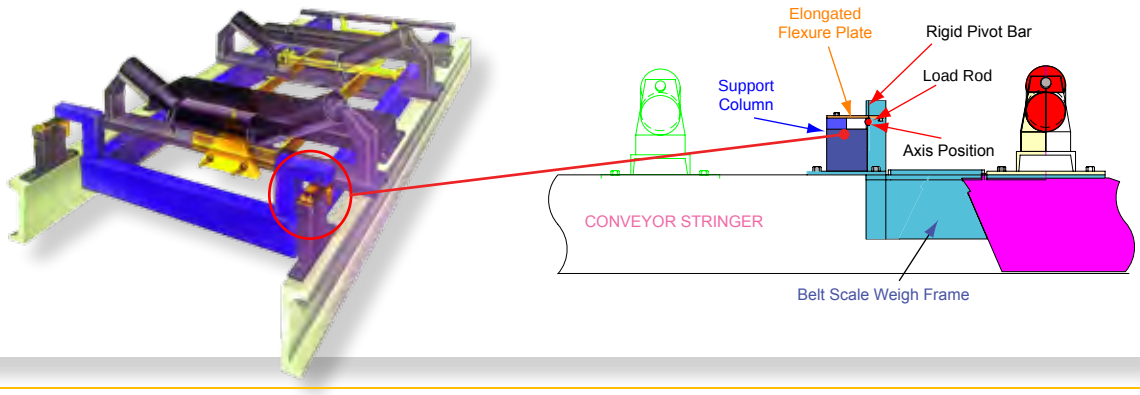
6. This unique system is not affected by dirt, shocks or vibration, and can withstand overloads in excess of 1,000 pounds without causing damage or affecting calibration.

THAYER's Patented "ROCKING FLEXURE" PIVOT

The axis position is permanent, being held in its horizontal position by the flexure plate and in its vertical position by the load rod which bears on the flexure plate, which in turn is bolted to the bottom side of the square and elevated suspension extension shaft.

There is insignificant rotational hysteresis. While the load rod may be likened to a dull knife edge (it is round), the flexure plate bearing surface directly in contact can rock without sliding through small rotational displacement.

The reaction to lateral forces creates an insignificant moment transfer to the weigh suspension (this is part of the patent). Since the flexure plate (which is hardened blue tempered steel) is also the upper bearing block of the pivot, tensile or compressive forces reacting to lateral forces therein have no moment arm distance to operate.



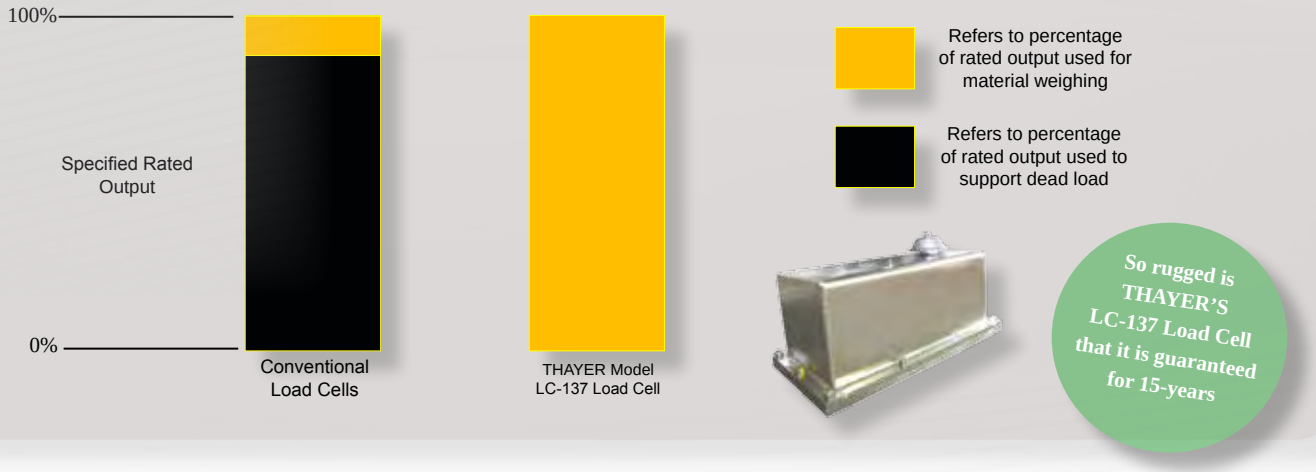
THAYER LOAD CELL / MODEL LC-137

Over 30 years of experience led Thayer Scale to the development of a load cell that is uniquely suited to conveyor belt scales and in particular Light Loading applications .

At Thayer Scale we custom build our load cells with capacity ranges that step up in fine, 5.0 lb increments. Our applications computer software can pick the best load cell for the job; one that will have a range that is ideally suited to the service it will perform. This, in culmination with our Isolation Lever and Mass Counterbalance enables us to reach >90% Load Cell Utilization Factor on all applications.

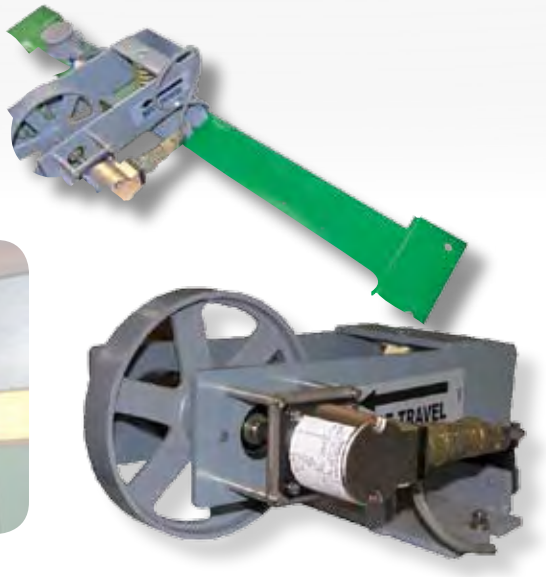
The Series LC-137 Load Cell is a high precision, high reliability LVDT (type) load cell specifically designed to interface with Thayer Scale's instrumentation and Force Measurement Suspension Systems ("FMSS"). Its flexible range of capacity offerings, superb accuracy and unequalled robustness is the result of a number of separate key developments in the fields of metallurgy, analog/digital circuitry, and "fine-tuning" software. Utilization of low expansion and constant modulus alloys on critical mechanical parts, precision grade excitation and A/D electronics, and proprietary linearizing and temperature compensating algorithms have produced an extremely accurate measurement device that can operate reliably in heavy industrial environments.

Model LC-137 Load Cell vs. Conventional Load Cell



PRECISION BELT SPEED MEASUREMENT

Accurate belt speed measurement requires the use of a precision wheel and pulser. A spring is used to maintain proper contact pressure of the wheel with the tension side of the belt in all operating conditions. The THAYER belt travel pulser assembly includes a precision cast/machined wheel with a "pre-calibrated" circumferential tolerance of ± 0.05% and a high resolution digital transmitter. The transmitter produces pulses equivalent to 1/100 to 1/200 of a foot of belt travel. The speed pick-up wheel has a narrow face width so it is less susceptible to material build-up, which can result in speed measuring errors. Since belt stretch is not constant throughout the length of the conveyor, and therefore, can affect speed measurement, the speed pickup produces a more accurate speed signal than that which is produced by tail pulley mounted speed encoders.



- Digital Pulse Output
- Heavy-duty Construction
- Spring loaded to maintain positive tracking
- Self-cleaning
- Minimum surface area for material build-up
- Easy to install
- Unaffected by temperature and voltage variations

CALIBRATION MADE EASY

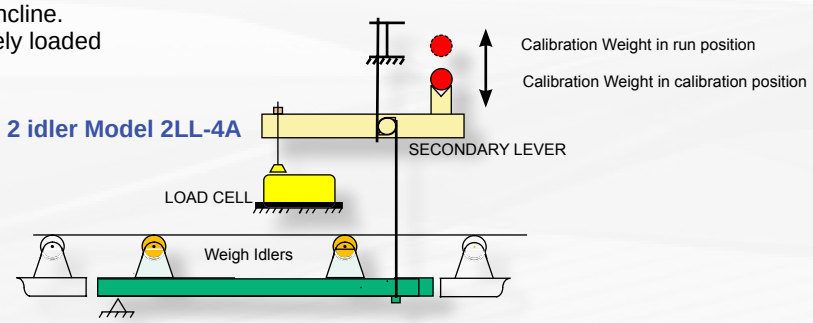
CALIBRATION

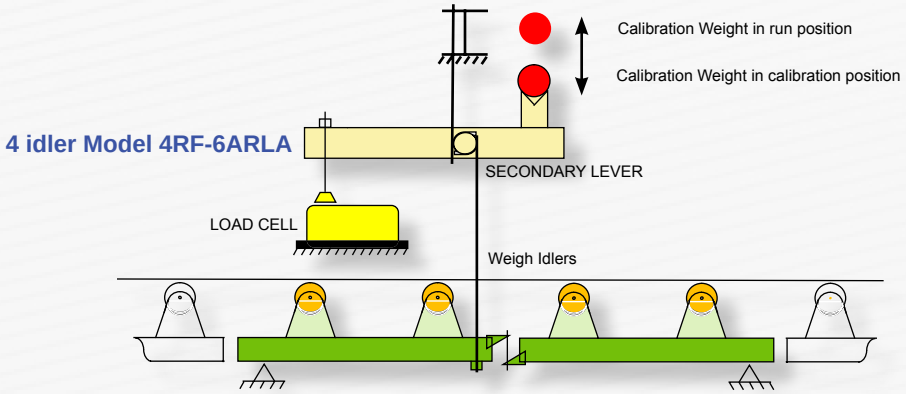
A belt scale should be thought of as a precision instrument and its performance should be quickly and easily checked. Thayer Scale can provide an accurate reliable calibration using a certified calibration weight instead of test chains or electronic simulation of load, for all scale capacities. Thayer Scale developed and patented the first automatic calibration system for conveyor belt scales in 1971.

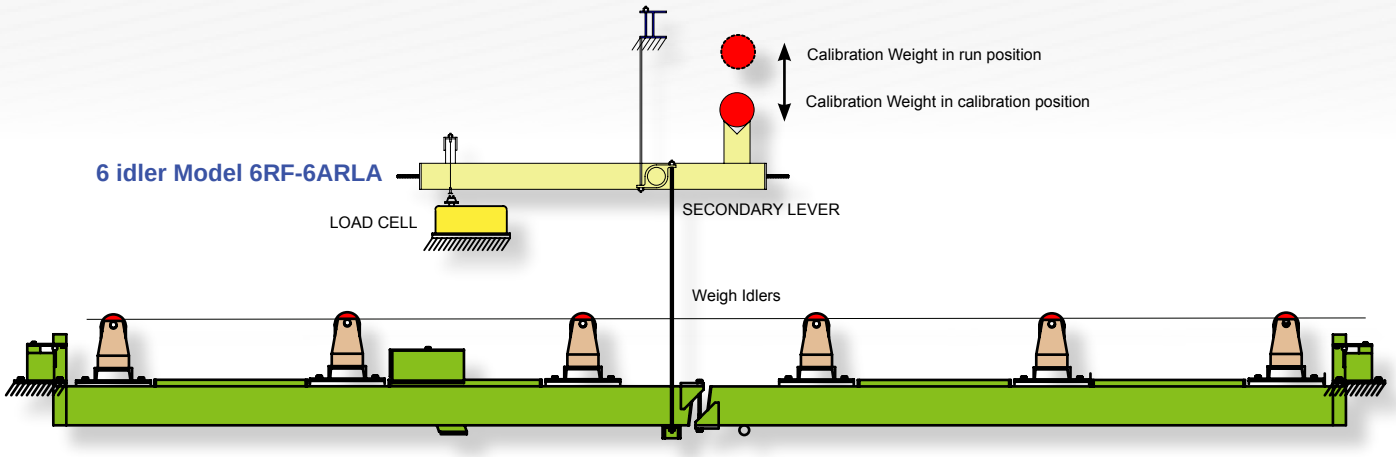
For belt scale calibration, Thayer Scale utilizes the test weight which represents a specific pound per ft loading value and an automatic belt length measurement system. This combination produces accurate, repeatable calibrations free from human error. Unlike electronic calibration which simply simulates a load cell output to the instrumentation, the test weight mechanically exercises the scale mechanism. Thayer's unique suspension design assures that the test weight will accurately load the scale and will weigh a maximum of approximately 60 lb (typically much lighter) while still representing 80-100% of full scale load. Calibration time is reduced to a matter of minutes and can be performed by one person.

Key advantages:

- Test Weight more manageable. One man operation.
- Loading effect independent of conveyor incline.
- Longitudinal restraining elements not falsely loaded







CALIBRATION TEST WEIGHT LIFT & STORAGE

Many plants have instituted safety procedures that prohibit operations personnel from being in close physical proximity to moving conveyors. Consequently, routine calibrations can become tedious as lock-out/tag-out procedures must be followed before test weights can be manually re-positioned. As most large conveyor belt drive systems allow for only so many re-starts in a given time frame, the calibration process can become time consuming, requiring extended process down time.

Recognizing that routine calibrations are more likely to be performed on a regular basis if they are easy to accomplish, Thayer Scale offers two different types of test weight placement methods.
A "manual" system and an automated test weight placement system. The manual test weigh lifter requires that the operator lift a lever to change the placement of the calibration weight. When using the Automated Test Weight Lifter (ATWL) the instrumentation automatically re-positions test weights at the proper time during the calibration routine, eliminating the need to stop and re-start the conveyor as well as eliminating the need for operators to be in close physical proximity to high speed conveyors. THAYER's Automated Test Weight Lift (ATWL) and Storage System provides quick, repeatable, and traceable calibration results without the need for operator intervention and with minimal process down time.

The test weight lift and storage assembly provides a safe, convenient method of placing the calibration weight on the scale weigh bridge accurately and provides these advantages.

- SAFE-eliminates need to go between belt strands.
- EASY-permits one person to operate.
- CONVENIENT STORAGE-prevents loss or damage.
- REPEATABILITY-weight is ALWAYS positioned in the same location test after test.

CALIBRATE

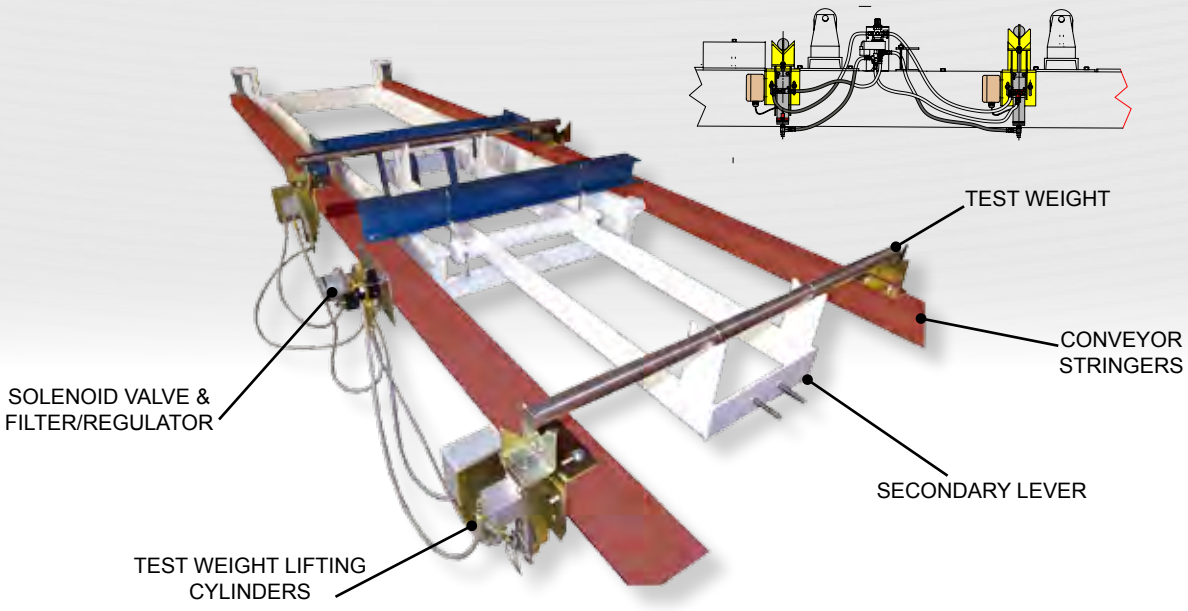
STORE

OPTIONAL AUTOMATED TEST WEIGHT LIFTER

THAYER's Automated Test Weight Lifter (ATWL) mechanism provides a means for applying a known CERTIFIED test weight to allow completely automatic calibration. The calibration sequence can be initiated via the belt scale instrument keypad or via a contact closure. A self-checking software algorithm in the weigh belt instrumentation prevents erroneous calibration. Test weight calibration eliminates the need for test chains. Two actuator assemblies lift and retract when signals from the instrument energize the solenoid valve assembly.

Each actuator assembly consists of a rod locking cylinder, flow controls, anti-rotation brackets and a junction box assembly. A limit switch on each actuator assembly provides position feedback to the instrument. One actuator assembly is required per test weight. Each complete ATWL assembly also consists of a Hose Cradle with a 2-position solenoid valve and a filter-regulator unit.

The cylinders supplied have a special rod lock feature. This feature will stop movement of the piston rod when less than 50 psi of air pressure occurs. When calibration is complete the actuators return to their original positions.



Thayer Scale Belt Scale and Weigh Belt Environmental Test Chamber

For weigh belt feeders and conveyor belt scales installed outdoors, extreme temperature swings can adversely affect their performance. The operating temperature limits of a weigh sensor can only be accurately determined and compensated for, by applying it to a simulated installation and subjecting it to varying temperature ranges.

In order to better assure customers of a successful installation of our products, an Environmental Test Chamber, located within the Thayer Scale manufacturing facility, provides a means for temperature testing of load cells, scale suspension systems, instrumentation and entire weighing and feeding machines.

This test chamber is equipped with special suspension loading “aids” (for precise positioning of static weights on the pivoted suspension members), for use in the manufacturing process of the RF Belt Scale and MD and MDL Weigh Belts.

The chamber finds use in Mechanical and Electrical Research and Development work, as well as in Production as a Quality Assurance tool where particularly stringent temperature specification are called for. A distinguishing feature of these confirmation tests is that they also include the effects of the lateral and longitudinal restraining elements required to hold the suspension in place on inclined conveyors.

A quality control procedure using the test chamber assures that the particular equipment being tested either meets or exceeds Thayer’s requirements for stable load cell output but in the case of commercial belt scales exceeds the stringent temperature requirements dictated by the NTEP phase 1 test procedures. The chamber tests also go beyond the scope of the present NTEP tests in that all active suspension elements, including those that are used to restrain the lateral motion of the scale on inclined conveyors, are tested for their combined effects.

Belt Scale Suspension Testing Conveyor

To aid in scale and conveyor design Thayer maintains a Belt Scale Suspension Testing Conveyor at its corporate headquarters in Pembroke, MA. This test conveyor was originally designed to study the effects of changing conveyor parameters on the accuracy of a particular scale’s loading signal as well as to compare the long term stability and reliability of speed measurements made at various locations within the conveyor. Currently it is used as an evolutionary development tool, where proposed design recommendations are simultaneously tested under identical conditions against existing configurations.

This test conveyor is 24” wide, 50 ft long, and can be equipped with 20 or 35 degree troughed idlers at variable spacing. It can operate under controlled belt tension from 500 to 1500 pounds, and belt speeds from 10 to 400 fpm. The conveyor is located outdoors to best simulate a customer’s installation and the effects of the environment (temperature swings of -15^0 F to $+90^0$ F) on scale performance.

The conveyor is equipped with a Thayer single idler Model “Quarry King” and 4 idler Model RF, Rocking Flexure Belt Scale. Both scales are outfitted with Thayer’s various instrumentation packages.

The potential performance level of a conveyor belt scale installation is dependent on things other than the belt scale itself. Major factors include: conveyor design, scale suspension design, location of load and speed sensors in relation to both conveyor terminal equipment and loading points, installed alignment conditions, duration and constancy of loading cycle, condition of rolling conveyor elements, the uniformity and stiffness of the belting itself, condition and size of take-up apparatus, the precision which the system can be routinely calibrated, adherence to calibration schedule, and operating environment.

While the Belt Scale Suspension Testing Conveyor can not simulate all the factors that directly affect a belt scale’s performance, it does provide many of the crucial variations in order to assure that a THAYER Belt Scale is designed for optimal accuracy and performance.

The SERIES 5200, Thayer Scale's new generation of operator interface for control and monitoring of any process weighing and flow control equipment.

- For use with any Strain Gauge or LVDT type load cells.
- Powerful internal 24 bit load resolution produces unparalleled system accuracy.
- Minimal customer wiring. The Scale Unit (SU-5200) mounted at the Belt Scale gathers, load, speed and temperature; and communicates this information to the central processor (CPU) through a 2-wire RS-485 connection.

SCALE UNIT (SU-5200)

This is the heart of the control system. It is responsible for continuously monitoring the major sensor signals of the process weighing equipment and digitally communicating their status back to the CPU for further processing. The Scale Unit consists of a motherboard that accepts several optional plug-in boards. These boards allow it to be easily applied to a variety of process weighing or flow equipment with sensors; LVDT and Strain Gauge Weight sensors, temperature sensors, two Channel Industrial Encoders, three Wire NPN Open Collector Proximity Switches or Piezoelectric Accelerometer speed sensors; and Analog or Digital flow rate sensors. The mother board is also equipped with digital Input/Output terminals that can monitor and/or control specific weighing equipment signals such as; Automated Calibration Devices, Belt Tracking Limit Switches and other similar devices. It is located within ten feet (three meters) of the load sensor (if applicable).

The Scale unit typically receives its power from the main instruments dedicated DC power supply and digitally transmits its information back to the instrument via an RS-485 communication link. Both of these cables are typically contained in a single dedicated conduit run.

SERIES 5200 CPU

The CPU is the brain of the control system. It is responsible for monitoring , displaying and/or controlling the variables of the process weighing or flow equipment. At the foundation of this instrument is the CPU or Embedded PC (EPC). This executes the proprietary application specific software based on real time operating system firmware. Both the software and firmware are stored in a nonvolatile memory format compact FLASH card. Sub-components of the instrument include: power supply that converts incoming AC power to the required DC supply for this unit as well as that required by the SU-5200 and OI-5200 Interface cards that handle the RS-485 communications between the SU-5200 and OI-5200 and Input/Output cards for the fixed and programmable inputs and outputs that are available.

OPERATOR INTERFACE

This is the human interface of the control system. It is responsible for providing the operator with a means of easily interfacing with the process weighing of flow equipment. It includes 24 graphic keypad controls, a 4 x 20 vacuum fluorescent display and audio beeper that combined provide visual as well as the tactile aid needed to program, operate, maintain, diagnose, and troubleshoot the entire control system.

Each application can contain up to three operator interfaces. One unit is typically mounted in the door of the instrumentation (CPU) and the others (if applicable) are shipped loose for remote mounting. Remote mounted units are available in industrial rated enclosures or as open chassis and are supplied if additional operator interfaces are required. Each unit, regardless of its location in the system, receives its information to and from the instrument controls via a communications link. A minimum of one operator interface unit is required for system operation.

MADE IN USA

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