TWISTLOCK CONTAINER WEIGHING SYSTEMS

A ROBUST AND ACCURATE WAY FOR GROSS MASS VERIFICATION

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In the first PTI Container Weighing EBook, published this April, 2016 the advantages and disadvantages of weigh bridges and twistlock based weighing systems have been outlined in detail.

Also, weighing systems installed on headblocks or in sheave pins versus spreader twistlock based systems have been discussed. One important fact to consider is that a weighing system installed on a headblock belongs to the crane, while a weighing system installed on a spreader is not a fixed part of the crane but of the spreader. The spreader can be removed to install, for instance, a coil boom or hook beam under the headblock. On the other hand, a headblock mounted weighing system does not allow determination of container load eccentricity as easily and as accurately as a spreader twistlock installed weighing system. It has already been voiced that the next regulation which IMO will issue on container handling, will be on limiting the eccentric loading of containers which will require weighing systems with load eccentric measuring capabilities. The other evident disadvantage of headblock based weighing systems is the impossibility to determine the weight of each container in twin-lift applications.

I would like to elaborate on different possibilities of using spreader twistlocks to weigh containers and verify the gross mass. There are solutions with load cells around the twistlock or products with a sensor inserted into the centre line of the twistlock, like LASSTEC using fiber optic technology with a Fiber Bragg Grating (FBG), which provides high measurement accuracy, an ideal compensation for temperature variations and insensitivity to shock loads and electromagnetic interferences.

FIBER OPTIC TECHNOLOGY

The major advantage of fiber optic technology is the load measuring range of the sensor that ranges up to the breaking point of the twistlock. This is based on the fact that the Young's modulus of fiber is much lower than that of steel and therefore fiber remains elastic and can still measure a load while the twistlock is reaching its breaking point. Once the twistlock breaks, the fiber also breaks as it is glued into the twistlock. But this high measuring range still allows accurate container weight verification when a twistlock has been over-stretched and needs to be replaced. Over-stretching of twistlocks can happen when a container is accidentally lifted only on one side.

In addition to the accurate container weight, following operational signals can be sent to the crane PLC to give notice of hazards:

- One or more twistlocks are under no load while lifting a container, e.g. when a twistlock is not correctly locked to the container

- A container is heavier than the maximum allowed weight
- A container is loaded beyond permissible eccentricity. This could happen as a result of load shifting during transit
- Snag loading. When lifting a container, there could be a so-called "snag" in a twistlock when e.g. one corner of a container is still locked to the container beneath or if the container jams in the ship cell
- Container dragging, which is when a corner of the unlocked twistlock gets caught in the container corner pocket after positioning and drags the container over the stack. This could happen especially within automated stocking yards
- No sensor signal, e.g. if a sensor or its wiring is defective

The central control unit of LASSTEC logs all load cycles and alarm events which involves several additional functions during the weighing process that contribute to the overall safety in the terminal.

1% ACCURACY

The resolution of the measuring points in the FBG sensor is from 40kg to 40kg increments. The twistlocks are "swinging freely" in the spreader to some extent, but it cannot be assumed that the pulling forces are always absolutely vertical. Containers might also be too distorted for the twistlocks to be perfectly vertical, resulting in a slight error. Thus, the system is specified to have a measuring accuracy in a static lift situation of +/- 1% at full scale or +/- 400kg over the complete measurement range (0 – 40 tons). A static lift situation means the machine or crane lifts the container up to a certain height without driving. In a dynamic situation, where the crane/machine lifts a container and drives simultaneously, the guaranteed accuracy is in accordance with the Maritime & Coast Guard Agency, UK (MCA). MCA stipulates +/- 400kg up to a load of 20 tons and +/- 2% of the actual load between 20 and 40 tons. For a container weighing 10 tons, this means an accuracy of +/-4%. At a load of 40 tons, this means an accuracy of +/-800kg. Different cranes and machines cause different degrees of dynamic oscillations when picking up a container and heavy containers cause more oscillations when being picked up than light containers. Ship-to-shore cranes are certainly the coarsest applications in terms of dynamic oscillations. Every application requires a different mode and setting to determine the verified gross mass (VGM). Current tests in dynamic stacking yard applications have proven the LASSTEC system to be within +/- 1% accurate of the actual load.

To guarantee an accurate weight verification over time, the zero load reading point is re-defined at each twistlock lock movement and set to zero. This eliminates the need to calibrate the system after a certain period of operation.

The alternative twistlock based solution to weighing containers is with a load cell around the twistlock which will be compressed when under load. The advantage is that load cells do not need to be replaced when the twistlocks are replaced; however, their measuring range is limited compared to fiber optic sensors. Shock loads can also damage load cells and plugs over time. Both systems have advantages and disadvantages which terminal operators need to evaluate, according to their optimal setting.

TOS INTEGRATION AND INTERFACES

The integration of the VGM into the terminal operating system (TOS) is an important element. 3 different pieces of information are required by the TOS:

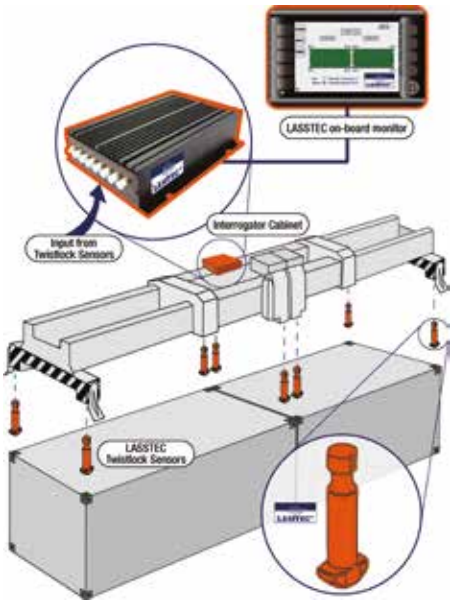
1. Verified Gross Mass
2. Container ID
3. Time Stamp.

The VGM and Time Stamp can be sent to the TOS in different ways. Either via the crane PLC, by TCP/IP from an on-board monitor in the crane cabin or through the Vehicle Monitoring Terminal (VMT) in the machine or crane.

While the VGM and Time Stamp are generated by the weighing system of the crane or machine, the terminal needs to be set-up to have the container ID available to combine it with the VGM and Time Stamp. For smaller terminals with Reach Stacker operations, where the TOS has no real time data about the containers being handled, Conductix-Wampfler offers keyboards which can be installed in the driver's cabin for entering the container ID and sending it to the TOS together with the VGM. For low volume container terminals, this is a very practical solution.

Another frequent requirement when weighing with Reach Stackers is to print out a "weighing" slip of the container being loaded. These weighing slips can then be added to the container manifest to serve as VGMs and also for invoicing purposes to the shippers.

As Reach Stackers are often used to handle exceptional loads such as flat racks which require Over Head Frames (OHF), it is important that these OHF tare weights can be deducted from the total load to be handled. There are a multitude of different OHF designs with different tare weights. The LASSTEC system offered by Conductix-Wampfler allows to deduct the tare weight of every OHF type and brand so that the net VGM is generated right when the load is being lifted.



ABOUT THE AUTHOR

Beat Zwygart is Market Manager Container Weighing at Conductix-Wampfler. He is the inventor of the patented LASSTEC Container Weighing System that uses the spreader twistlocks as load cells and was Managing Director of LASSTEC Sàrl that has been acquired by Conductix-Wampfler in September, 2013. Prior to establishing LASSTEC in 2008, Beat Zwygart was Director of the marketing company of ELME's crane spreader division that he founded in 1994 together with the Swedish mother company. Before joining ELME, Beat was 17 years with Caterpillar where he had several managerial positions in Geneva Switzerland, the US and in the Middle East, mostly for products used in the container handling industry. Beat Zwygart was born in Switzerland and has a degree in Mechanical Engineering. He is also a member of the ICHCA ISP Panel and of PEMA.

ABOUT THE ORGANISATION

Conductix-Wampfler is one of the world's leading suppliers of energy supply and data transmission systems for moving machinery and offers all available technologies and products to meet flexible and mobile energy and data transmission requirements, all from one source. Energy and Data Transmission Systems play a very crucial role in these operations and they receive special attention by the operators, as well as by the equipment manufacturers and consulting engineers.

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