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Comments on S&T Item ABW-4

Submitted by Dick Suiter

Richard Suiter Consulting

History of automatic bulk weighing systems

In the late 70's or early 80's a manufacture produced an electronic weighing system designed to be a replacement for the old mechanical "trip weighers" which were a mechanical hopper scale that would fill with grain to a mechanically "preset weight" then trip and dump. The trip weighers were typically located in the head house of a grain elevator and used to fill railway grain cars. When the car was full it would then be weighed on a railway track scale to make the final determination of the net weight of grain in the car. The intent of the new electronic system was to replace both the trip weigher and the railway track scale. The new systems were intended to comply with the scale code section 2.20 in Handbook 44. The systems consisted of a large upper garner, a weigh bin, and a large lower garner. The upper garner would hold a large quantity of grain that would then be fed into the weigh bin in "smaller" loads. The weigh bin would then empty into a lower garner or surge bin to keep the flow of grain into the rail car more consistent and lessen or prevent gaps in the flow followed by large surges of grain. Many successive drafts were added together electronically to arrive at a net weight of the total net load in the rail car. Virtually all bulk weighing systems in use today for weighing grain still incorporate a large upper garner, a weigh bin, and a lower garner or surge bin.

One of these systems was installed at a large grain elevator in Nebraska. Early on a problem was discovered with the system, in that sometimes the weigh bin would not empty completely when dumping into the lower garner returning to a load on the plus side of zero with the weigh bin gate closed. In order to comply with the scale code in Handbook 44 the scale would automatically zero itself between drafts which meant that zero load value now included some grain (often referred to as a "heel") still in the weigh bin. At some point during a subsequent draft the "heel" would pass out of the weigh bin along with the rest of that respective load. When that happened and the indicator would return to a value on the negative side of zero. In this early design the negative value would cause the system to lock up, cease to function, and require the intervention of an operator to reset the system before weighing could continue. This system as designed would not comply with all requirements of Handbook 44, relative to return to zero on a decreasing load, in place at the time.

The manufacturer of the system worked closely with the State of Nebraska and the USDA Grain Inspection Service (GIPSA) in an attempt to resolve the issues and recognize a new design using new technology to fill a need in the market place. In 1981 GIPSA began working with the S&T Committee of the NCWM to develop a new criteria for Handbook 44 that would recognize a system that would utilize a "no load reference value" that was other than zero and could be on either the positive side or negative side of zero. The S&T Committee and GIPSA quickly recognized the best way to accomplish that goal was to develop a new code for addition to the handbook. The initial version of the Automatic Bulk Weighing Systems for Grain (ABWS) Code for Handbook 44 was adopted by the NCWM in 1983. Over time several revisions and additions to this initial code have taken place.

Notably the addition of a requirement for overfill sensors were added in 1993 and 1998 respectively. The requirement in 1993 was added to prevent inaccurate weighments if the weigh bin was overfilled to the point of causing contact between the grain being weighed and the outlet of the upper garner. In 1998 a similar requirement was added for systems that utilize a lower garner. Many of the system used in the grain or flour industries incorporate closed boots for dust control between the weigh hopper and the upper and lower garners. These boots can easily cause interference in the weighing process if the weigh hopper or lower garner is overfilled with the product rising in a cone fashion making contact with the dust control boot above.

During the development of the ABWS Code a number of safe guards were added due to the fact that in most cases a fairly large number of drafts would be added together to arrive at one total weight. ABWS systems measure only one commodity from start to finish and are not historically used to develop a different finished product.

Of further note and importantly in 1985 when the S&T Committee was developing the Automatic Bulk Weighing Systems Code for adoption into NIST Handbook 44 the Committee stated that the Automatic Bulk Weighing Systems Code did not apply to "Batching Systems" and stated that the Scales Code would apply to Batching Systems. However there is no "exceptions" paragraph in the ABWS Code similar to those in several other Handbook 44 Code. Perhaps, this leads to confusion and difficulty for W&M Officials in the field and leads to trying to "pigeon hole" all automated systems into the ABWS Code when they should in fact be evaluated using the Scales Code.

NTEP has issued Certificates of Conformance for other systems that utilize a controller to automate the operation of some weighing systems including batching system. The evaluation of these systems were conducted using the scale code section 2.20 of Handbook 44.

A copy of S&T Item 304-3 can be reviewed on page 123 of the Committee Report of the 70th National Conference on Weights and Measures 1985. A copy of that page is attached for your convenience.

304-3 APPLICATION OF THIS CODE TO ALL SYSTEMS.

(Information item)

A recommendation was received that this Code be amended to include all such systems, not only those used for weighing grain. The Committee agrees in principle with this suggestion but is not certain that time is sufficient to adequately determine the impact on all other such systems used for weighing other materials. The Committee's greatest concern is with systems used to weigh construction materials such as sand and gravel, or minerals such as coal and ore.

A brief overview of this code seems to indicate that all other systems could be included with the following changes or additions:

T.2.1. MINIMUM TOLERANCE VALUES/FOR SYSTEMS USED TO WEIGH CONSTRUCTION MATERIALS. - The minimum maintenance and acceptance tolerance shall be 0.1 percent of the weighing capacity of the system, or the value of the scale division, whichever is less.

T.3.1. BASIC TOLERANCE VALUES/FOR SYSTEMS USED TO WEIGH COMMODITIES OTHER THAN GRAIN. - The basic maintenance tolerance shall be two pounds per 1000 pounds of test load (0.2 percent). The basic acceptance tolerance shall be one-half the basic maintenance tolerance.

UR.1.1. SELECTION REQUIREMENTS/FOR SYSTEMS USED TO WEIGH COMMODITIES OTHER THAN GRAIN. - The number of scale divisions shall not be less than 500 or greater than 10,000.

UR.3.1. LOADING REQUIREMENTS/FOR SYSTEMS USED TO WEIGH COMMODITIES OTHER THAN GRAIN. - A system shall not be used to weigh drafts of less than 20% of the weighing capacity of the system except for a final partial draft.

If the comments received are mostly positive and any negative comments can be properly addressed, the Committee will recommend adoption by the 71st Conference.

The Committee reminds the Conference that this code does not apply to batching systems, for which the Scale Code applies.