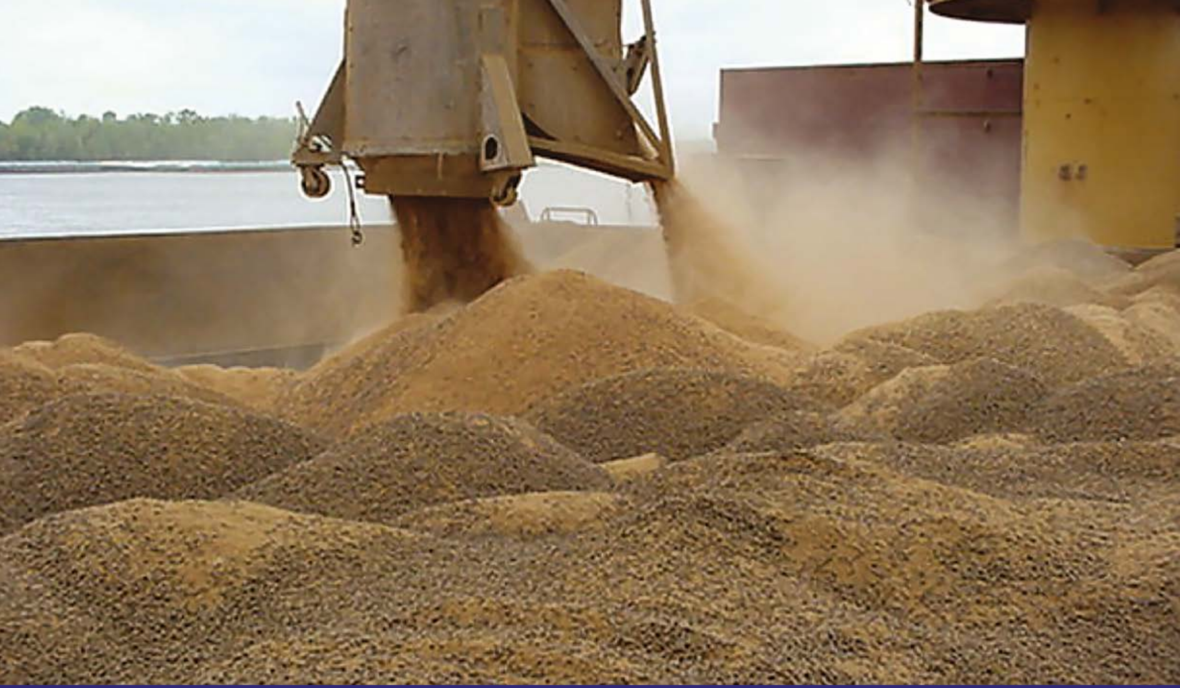

Chapter 3 – Cargo Measurement

During the transportation of bulk cargo, some losses will unavoidably occur. However, when the shortages exceed a percentage regarded as customary in that trade, the carrier is often held responsible. One of the causes of shortage claims is that it is virtually impossible to precisely determine the weight of large quantities of dry bulk cargoes, either afloat or ashore. Chapter 16 describes the measurement of dry bulk cargoes using draught surveys, while this chapter refers to the specifics of bulk grain measurement.

3.1 Determination of Weight Ashore

Various methods are used to determine the weight of a grain cargo when it is still ashore. The common ones are:

- Weighbridges
- mechanical weighing
- fixed and mobile bag weighers
- automatic bulk grain weighers
- automatic load cell gross weighers
- conveyor belt weigh systems.

3.1.1 Weighbridges

These heavy-duty machines for the weighing of empty and fully loaded road vehicles are generally intended to operate in a wide range of temperature conditions, from minus 10°C (–10°C) to +50°C, depending on local regulations. In extreme conditions, where temperatures may be regularly outside these parameters, the manufacturers should be consulted.

Because of the manner in which weighbridge scales are graduated and operated, manufacturers can only guarantee an accuracy of half of one scale division or less.

Therefore, on a 20 T weighbridge, with 10 kg divisions, the error could be ±5 kg (±0.025%). An 80 T weighbridge will have an accuracy of ±10 kg (±0.0125%). Most weighbridge systems can account for any debris, water, ice or snow that may have accumulated between one lorry being weighed and the next.

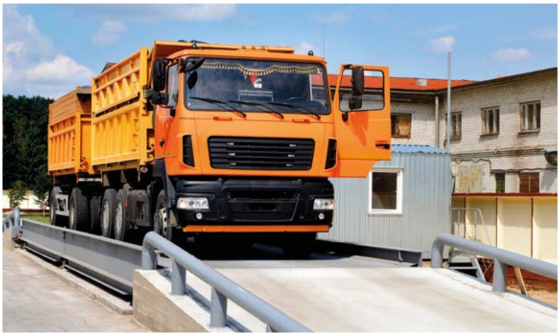

Figure 3.1: A weighbridge.

3.1.2 Fixed and Mobile Bag Weighers

These include:

- Semi-automatic machines that are suitable for low output, low-cost bagging requirements
- portable automatic bag weighers that can deal with both sacks and bulk
- fully-automatic bag weighers that will record both gross and/or net weights and that are suitable for flow materials such as grain, granular fertiliser, seeds, pulses, pellets, plastic granules, rice, refined sugar and other similar products.

These machines may be accurate to within ±1% for bags weighing between 20 and 50 kg.

When weights increase to 100 and 250 kg, accuracy will improve to between 0.5 and 0.2%.

The degree of accuracy depends on:

- The index allowances set by the operator for the weight of an empty bag
- the degree of care exercised by the operator in maintaining the mechanical system.

3.1.3 Automatic Bulk Grain Weighers

These machines are suitable for weighing grain and free-flowing materials fed from elevators, conveyor belts, storage hoppers or silos. They are produced in various sizes and can record weight cycles from 30 kg up to 5 T. They can deliver at rates of up to 1,000 T/hour. When this machinery is correctly installed and maintained by the manufacturers, and regularly inspected by a reliable local regulatory authority, an accuracy of ±0.1% is likely.

3.1.4 Automatic Load Cell Gross Weighers

These machines are designed to handle grain sizes not greater than 25 mm. They are used in continuous weighing cycles of 10 to 50 kg and their accuracy is better than 0.2% in most cases.

3.1.5 Conveyor Belt Weigh Systems

There are a number of conveyor weigh systems and, at best, their margin of error is likely to be within 0.5% of true weight for capacities of up to 6,000 T/hour, increasing to 1 to 2% of true weight for flow capacities of 2,000 T/hour.

Ivan Kuzukin/Shutterstock.com

Figure 3.2: Conveyor belt system in Canada.

Where an unexplained short-landing occurs at a discharge port, the conveyor belt weigh system may prove to be a worthwhile field of investigation. If the cargo has been loaded and weighed on a conveyor system, both the load port terminal and the discharge port terminal should be asked to produce the manufacturers' full specification and brochures for the equipment utilised. If the guaranteed accuracy is not better than between 1 and 2% of true weight, considerable errors may arise. For a shipment of 100,000 T, for example, an indicated 'loss' of 2,000 T might be possible, where accurate weighing would have probably indicated a discrepancy of no more than 500 T (based on a 'transport' difference of 0.5%).

3.2 Determination of Weight on Board Ship

There are two methods of determining the weight of a dry bulk grain cargo loaded on board a ship:

- On the basis of the free space in a compartment (measurement and stowage factor)
- on the basis of draught surveys (see Chapter 16).

3.2.1 Measurement and Stowage Factor

On completion of loading, the free space in each cargo hold is measured and, from this, the volume occupied by the cargo is calculated. This volume, when divided by an assumed stowage factor, gives the approximate weight of the cargo. This method is no more than an estimation and the exact stowage factor is seldom known, so the assumed figure may be quite inaccurate. The stowage factor can only be ascertained correctly by laboratory analysis of samples from the cargo, which take into account the nature of the cargo, the moisture content, the percentage of foreign matter present and the age of the commodity.

The stowage figure may also vary considerably for other reasons. For example, in grain cargoes, 'spout lines' may develop because grain in a cargo hold tends to separate into heavier and lighter components. In addition, almost all bulk grain cargoes settle during transportation as the kernels and shells collapse. The result of this is an increase in weight per unit volume and a lower stowage factor. In such cases, and if the same assumed stowage factor was used, it would be unsurprising that the weight of cargo calculated on the basis of free space measurement after loading would indicate a greater quantity of cargo than that calculated before discharge.

It is probably reasonable to say that the accuracy of shore weighing of bagged and bulk commodities is unlikely to be better than within 0.2% and, in conveyor belt weigh systems, may be no better than ±2%. There are no technical means by which the exact weight of a dry bulk cargo on a ship may be accurately determined. The weights may be approximately determined by free space measurement or by draught survey, but neither of these methods is sufficiently accurate to verify the weight of a cargo as stated by shippers, nor to determine any loss of cargo in transit.