
**Equipment for harvesting — Combine
harvesters — Determination and
designation of grain tank capacity and
unloading device performance**

*Matériel de récolte — Moissonneuses-batteuses — Détermination
et désignation de la capacité et des performances du dispositif de
déchargement des trémies à grain*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 7, *Equipment for harvesting and conservation*.

This third edition cancels and replaces the second edition (ISO 5687:1999) which has been technically revised.

The main changes compared to the previous edition are as follows:

- in [Clause 1](#) (Scope), addition of "preferred" method;
- in [Clause 2](#) (Normative references) addition of ISO 4254-7 and ISO 6689-1;
- addition of [Clause 3](#) (Terms and definitions);
- in [Clause 4](#) (Test method):
 - addition of test machine requirements,
 - addition of requirements for taking samples,
 - clarification of the test procedures;
- sub-division of the test results clause (now [Clause 5](#));
- in [Clause 6](#) (Information to be documented), heading change from "to be reported" to "to be documented" and more detailed list of items.

Equipment for harvesting — Combine harvesters — Determination and designation of grain tank capacity and unloading device performance

1 Scope

This document specifies a preferred method for determining and designating the capacity and unloading rate of combine harvester grain tanks and unloading systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 712, *Cereals and cereal products — Determination of moisture content — Reference method*

ISO 4254-7, *Agricultural machinery — Safety — Part 7: Combine harvesters, forage harvesters, cotton harvesters and sugar cane harvesters*

ISO 6689-1, *Equipment for harvesting — Combines and functional components — Part 1: Vocabulary*

ISO 7970, *Wheat (Triticum aestivum L.) — Specification*

ISO 7971-2, *Cereals — Determination of bulk density, called “mass per hectolitre” — Part 2: Routine method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6689-1 and ISO 4254-7 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Test method

4.1 Test machine

4.1.1 The test combine harvester shall be identified as to make, model year, machine identification number, grain-unloading device description, and other pertinent information.

4.1.2 The terminology and methods or measurement defined in ISO 6689-1 shall be used where applicable.

4.1.3 The combine harvester used for the test shall be equipped with a header typically used to harvest the wheat. The machine configuration shall be documented in the test report.

4.1.4 At the time of the test, the test combine harvester shall be in good working order with all working surfaces free of rust, grease or other impediments to normal operation. A run-in period of minimum 3

grain tank fill-and-empty cycles is required to ensure this condition on a new combine harvester, or one that has not been used recently.

4.2 Test preparations

4.2.1 During all portions of the test, the combine harvester shall be stationary, placed horizontally on a level surface and running at rated speeds with the feed table (header) and threshing mechanisms engaged. During the unloading portion of the test, the unloading device shall also be engaged at rated speed with the feed table (header) and threshing mechanisms previously engaged.

4.2.2 The wheat used for testing shall have a wet basis moisture content between 10 % and 17 %, measured in accordance with ISO 712, and a maximum impurity level of 3 %, measured in accordance with ISO 7970. The mass per litre of the test wheat should be no less than 0,73 kg/l and no greater than 0,81 kg/l in accordance with ISO 7971-2. A sample of the test wheat shall be taken. The wet basis moisture content, and the impurity content, in percent by mass, shall be determined and recorded. The mass per litre, in kg/l, shall be determined and recorded.

4.2.3 To ensure that the grain tank and unloading device are effectively empty before starting the rating tests, operate the grain-unloading device until the main unloading stream of grain has stopped and then continue to run the grain-unloading device for at least one more minute before stopping.

4.3 Test procedure

4.3.1 Fill the grain tank with the test wheat by means of its own loading system up to, but not beyond, the point of spillage.

4.3.2 Measure the unloading rate using one of the procedures described in [4.3.2.1](#) or [4.3.2.2](#).

4.3.2.1 Recommended procedure is to unload the combine and continuously measure weight vs time at a minimum frequency of 5 Hz. Commence unloading the test wheat from the combine harvester grain tank using the combine's grain-unloading device operating at its rated speed into a suitable collection area for weighing the wheat, at the same time recording the weight vs time. The starting time is the moment when the unloading switch or lever is activated by the operator. Continue unloading for 30 s after the flow of wheat stops to ensure sufficient data collection. The point at which the grain tank is effectively empty will be calculated as described in [5.2.1](#).

4.3.2.2 Alternate procedure is to commence unloading the test wheat from the combine harvester grain tank using the combine's grain-unloading device operating at its rated speed into a suitable collection area for weighing the wheat, at the same time noting the starting time. The starting time is the moment when the unloading switch or lever is activated by the operator. Five seconds after the start of full flow from the grain-unloading device, divert the wheat into a second suitable collection area. After a further 30 s, divert the remaining wheat being unloaded into the first collection area until the flow of wheat stops, when the grain tank is considered to be effectively empty. Weigh and document the mass of test wheat collected in the first and second collection areas. Document the total time.

5 Test results

5.1 Maximum unloading rate

5.1.1 For the procedure prescribed in [4.3.2.1](#), the maximum grain tank unloading rate, in litres per second, shall be calculated based on the 30 s period with the highest unloading rate.

5.1.2 For the procedure prescribed in [4.3.2.2](#), the maximum grain tank unloading rate, in litres per second, shall be calculated using the mass of the wheat collected in the second collection area divided by the mass per litre of the test wheat determined in [4.2.2](#), and then divided by 30 s.

5.2 Unloading time

5.2.1 For the procedure prescribed in [4.3.2.1](#), the grain tank unloading time shall be given as the time, in seconds, between the activation of the unloading system and the point at which the unloading rate, filtered as a 1 s moving average, falls to 2,0 % of the maximum rate, as determined in [5.1.1](#) (effectively empty).

5.2.2 For the procedure prescribed in [4.3.2.2](#), the grain tank unloading time shall be given as the time, in seconds, between the activation of the unloading system and the point at which the grain tank is effectively empty, as determined in [4.3.2.2](#).

5.3 Grain tank capacity

5.3.1 For the procedure prescribed in [4.3.2.1](#), the designation of grain tank capacity, in litres, shall be calculated by dividing the total mass of wheat collected in the time determined in [5.2.1](#), by the mass per litre of the test wheat determined in [4.2.2](#).

5.3.2 For the procedure prescribed in [4.3.2.2](#), the designation of grain tank capacity, in litres, shall be calculated by dividing the total mass of wheat collected in both collection areas by the mass per litre of the test wheat determined in [4.2.2](#).

5.4 Average unloading rate

The average grain tank unloading rate, in litres per second, shall be calculated by dividing the grain tank capacity as determined in [5.3](#) by the total grain unloading time determined in [5.2](#).

6 Information to be documented

When reporting test results, values for capacity and rates shall come from the same test.

From each test, the following information shall be documented:

- a) machine feed table (header) and grain-unloading device description and model number;
- b) machine identification number;
- c) test method used: recommended ([4.3.2.1](#)) or alternative ([4.3.2.2](#));
- d) grain tank capacity, in litres;
- e) average grain tank unloading rates, in litres per second, reported as "average unloading rate";
- f) maximum grain tank unloading rates, in litres per second, reported as "maximum unloading rate";
- g) moisture content, impurity level and mass per litre of the test grain sampled in [4.2.2](#);
- h) grain tank unloading time, in minutes and seconds;
- i) name of the technician performing the test;
- j) location of the test.

7 Grain tank capacity designation

The grain tank capacity designation of a combine harvester at a stationary state shall be the number of litres of wheat, rounded upwards to the nearest 100 l, that are unloaded according to the method specified in [Clause 4](#).

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