International agricultural machinery standards for the benefit of agriculture and industry

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1. Introduction

International standardization for tractors and agricultural machinery was started in 1952 by the creation of ISO/TC 23 'Tractors and machinery for agriculture and forestry'. In the course of time the expectations with respect to the subjects of standardization and the technical specifications changed significantly. The individual phases may be distinguished as follows [1 amended]:

- 1950s: reduction of variety of types and designs;
- 1960s: interchangeability and usability;
- 1970s: ergonomics and operator’s safety;
- 1980s: tractor & implement interfaces (up-dating);
- 1990s: operator’s safety (CEN) and electronics (ISO);
- 2000s: consideration of systems and processes.

These various phases show the continuous stakeholder orientation of agricultural machinery standardization. Whilst at the beginning the interests of tractor and implement manufacturer were playing the leading role, later on the customer’s needs and political developments (e.g. the single market in Europe) got more and more importance.

2. Need for standardization

2.1. Interchangeability

Agriculture is characterized by the high degree of heterogeneity with respect to the growing conditions & strategies and the resulting methods of operation. The agricultural industry offers a wide range of specific machines adapted to the individual conditions. Due to the leading role of tractors for the mechanization of agriculture and the need to design the process chains according to the local conditions standardized interfaces are necessary to allow the farmer the choice between the various tractor and implement types. The mechanical interfaces for mounting (three-point-linkage / ISO 730) and powering (power take-off PTO / ISO 500) were standardized at early stage but require the permanent adaptation to the state of art with respect to the increasing performance of the tractors and implements. The most recent amendment to the PTO standard allows now the transmission of mechanical power of up to 450 kW.

As modern agricultural equipment is not only most powerful but also intelligent the publication of the ISOBUS standards ISO 11783 shall be seen as an important milestone. This standard allows the data transfer between tractors and implements and via the so-called task management the data exchange with the management software in the farmer’s office. In the meantime it is obvious that ISO 11783 is much more than a standard and ISOBUS should be seen as a technology allowing developing more functionalities such as headland management or auto-guidance systems.

2.2. Implementation of legislation
As other sectors too, agriculture is faced with an increasing volume of legislation. With respect to machinery, requirements concerning the operator’s safety, protection of the environment and safe road transport have to be fulfilled. However, the specific conditions in agriculture require specific regulations considering:

- the typical operating conditions such as:
  - seasonal use and wide range of crop, weather and soil conditions;
  - availability at any time allowing to use the optimum time window;
  - robustness ensuring a high degree of reliability;
- the machine functions such as:
  - direct contact with soil and crops;
  - high volumes of material to be picked-up, worked, stored and distributed again or overloaded;
  - unhindered material flow as one of the most important design objectives (for economic and safety reasons).

The legislation in Europe but also in other regions accepted that standardization is a qualified and trustful partner being able to provide appropriate technical specifications in order to support the implementation of the general legal requirements. In the meantime safety standards are available for most agricultural machines. Many are published as EN ISO standards ensuring the acceptance on the European and international level, see for example the general safety standard EN ISO 4254-1.

Comparable to the operator’s safety, the protection of the environment when applying pesticides is supported by the specifications of EN ISO 16119 and EN ISO 16122 showing the state of art of new sprayers and providing recommendations for their routine inspections.

With respect to road transport standardization put its focus on components such as steering and braking systems or components for hitching. The series of hitch standards covers the wide range of different coupling devices and is used in national or regional type approval procedures for on road use of tractors and machines.

2.3. Co-operation

The role of standardization as platform for co-operation is sometimes underestimated. International standardization committees and working groups allows the contact to highly qualified experts coming from different organisations (agricultural machinery companies, advisory bodies, scientific and research institutes, test houses, authorities, …) and disciplines (agriculture, mechanical engineering, communication & information technology) and the access to knowledge on the international level. Therefore, especially for small and medium sized enterprises standardization provides the unique opportunity to contribute to the challenges the sector is faced with and allows personal profit.

3. Development of standards

International standardization is characterized by very clear rules and processes and stands for the discussion of interested parties which is based on technical arguments and searching for consensus on the individual issues. The roles of the involved parties are allocated:

- chairman and secretary of committees have to ensure that:
  - rules and procedure are kept (e.g. target dates);
everybody can show his view:
  - the achievement of consensus is facilitated;
- the ISO (or CEN) members have to ensure that:
  - all interested parties are involved and balanced national views are presented;
  - standardization projects are actively supported by providing technical input.

The committees of TC 23 are most careful to follow these rules in order to ensure the acceptance of their published standards and contribute to an efficient, time and resources saving working style.

4. Today’s core areas and projects

The actual main topics in the field of standardization for agricultural machines may be shown by referring to the most active sub-committees (SC) of TC 23 which are:

- SC 2 and 4 dealing with test methods and tractors;
- SC 3 as horizontal safety committee;
- SC 6 and 7 as product committees for sprayers & harvesting equipment;
- SC 19 as horizontal committee for electronics.

In addition to the continuous up-dating of its published standards (e.g. standards specifying the mechanical and hydraulic interfaces between tractors and implements) the tractor committee SC 4 decided to revise the tractor safety standard ISO 26322. The main objective is to complete the 2008 edition by amending high-quality requirements in order to consider the actual state of art of tractor technology and to allow the replacement of national and regional tractor regulations. To achieve this target a task force was installed to plan the revision.

The committee for testing, SC 2, still makes efforts to convince OECD that joint (ISO OECD) standards would be very useful for both organisations and would provide additional benefit for their stakeholders – especially farmers and industry. ISO and OECD already signed a memorandum of understanding in order to avoid the present duplication of work with respect to the testing of roll-over protective structures but unfortunately, this memorandum was cancelled again before coming really into force.

The safety committee SC 3 provided a new version of EN ISO 4254-1 in 2013. This version now deals with all relevant risks for agricultural machinery and provides general safety requirements applicable to all types of mounted, towed or self-propelled machines. Due to its status – EN ISO – the standard provides the so-called presumption of conformity with respect to the European machinery directive and gets high acceptance in other regions. Having provided the new version of the basic standard SC 3 continues with the alignment of the machine specific standards such as soil working equipment, seed drills and fertilizer distributors. Very new items on the SC 3 agenda are the projects dealing with high voltage systems and automated machine operation.

The work on safety standards is completed by the harvesting committee which is dealing with the revision of the safety standard for combine, forage and cotton harvesters (EN ISO 4254-7) and the new safety standard for bale wrapping machines. The revisions of the baler and mower standards are already announced.

As a consequence of two EU directives:
- 2009/127/EU amending the machinery directive to include pesticide application equipment;
- 2009/128/EU framework directive dealing with the sustainable use of pesticides.
The sprayer committee SC 6 developed the environment related standard series EN ISO 16119 (new sprayers), EN ISO 16122 (inspection of sprayers) and EN ISO 19932 (knapsack sprayers). These new standards caused the revision of existing sprayer standards which specify test procedures and are used as reference standards.

The ISOBUS standard ISO 11783 is the core standard of the electronic committee SC 19 and allows the communication between tractors, implements and farm management systems. This standard consists of 14 Parts and requires the permanent adaptation to the state of art and the inclusion of new functionalities in order to reflect the developments in the IT sector and to ensure the interchangeability (“plug and play”). Additional standards will be necessary to allow the automated operation of individual machines as well as the aligned operation of various machines (fleet management).

5. Future challenges

The above shown examples illustrate that international standardization is faced with an increasing number of requests for new standards or the adaptation of existing ones. The number of projects and the complexity of new projects in the field of new technologies on the one hand side and the request to provide the standards much faster on the other side cause a conflict due to the limited resources. To resolve this conflict the improved co-ordination and the setting of priorities might be a first but not sufficient answer.

The advancing globalization allows and requests the integration of new partners into the standardization network. By this integration more resources will be available and the acceptance of ISO standards in the new markets will be increased. However, due to the individual market conditions different types of machines are needed to satisfy local demands. As consequence standardization is faced with the question how to satisfy the requests of highly developed and developing markets by one high quality standard.

6. Conclusions

The international standardization for agricultural machinery and tractors has a long and successful tradition. Due to the voluntary involvement of experts a very complete and appropriate set of standards could be developed. By these standards the main targets

- interchangeability between tractors, implements and farm management systems and
- safe and environment friendly use of machines

are achieved. The speed of the technical development and the integration of new markets require additional efforts to satisfy the stakeholder needs. ISO committees and ISO as organisation are requested to continue the way of increasing their efficiency.

References