

## ISO Harvesting and conservation standards - Mowers and balers

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### 1. Introduction

Mowed fields and trimmed hedgerows are key for planting, growing and harvesting crops and for keeping our roads clear of encroaching vegetation [1].

Likewise crop gathering and storage are just as important, and our remit as standards developers is to provide safe machines with ergonomic designs, inclusive and as part of the essential criteria to compliment the food chain. Consideration is given therefore of:

- an understanding of standards development globally and legislative requirements;
- the appreciation of safety aspects of complex machinery;
- long term challenges related to conservation and sustainability.

### 2. Standards

#### 2.1. Development

Although standards take time to develop and some years to publish, the ISO/TC 23/SC 7 group I have been privileged to steer since 2007, has diligently worked to produce a suite of standards that will enhance the safety of new machinery. Testing in several countries, analysis of thrown object data, material behaviour, guarding strength and longevity as well as cycle times, have been explored in the production of several standards.

#### 2.2. Mowers and balers

The main challenges for mowers was to increase blade quality, reach thrown object testing global parity for guarding, and the introduction of new scopes to encompass the various sizes of machinery, while taking into account the many different situations all over the world. Thrown object testing criteria has also been mirrored across to the verge cutting and highway maintenance machinery sector. For main stream pick up balers, it was time to reduce hazards and increase greater safe working practices for the operator. As the state of art changes, different bale sizes emerge and as a risk of unauthorised use appeared to be increasing, reminded of a gap in the series of requirements. A new standard, due for publication in 2014, has been developed for the bale-wrapper versions with this in mind.

### 3. Conclusions

Over the last few years the following safety standards have been introduced:

- **EN ISO 4254 – 12:2012** Agricultural machinery – Safety – Rotary disc and drum mowers and flail mowers;
- **ISO 4254 – 13:2012** Agricultural machinery – Safety – Large rotary mowers;

- **ISO 5718:2013** (2002) Harvesting equipment – Blades for agricultural rotary mowers – Requirements;
- **ISO 17101 - 1:2012** Agricultural machinery – Thrown-object test and acceptance criteria – Part 1: Rotary mowers;
- **ISO 17101 - 2:2012** Agricultural machinery – Thrown-object test and acceptance criteria – Part 2: Flail mowers;
- **ISO 17103:2009** Agricultural machinery – Rotary disc mowers, rotary drum mowers and flail mowers – Test methods and acceptance criteria for protective skirts;
- **EN ISO 4254 – 11:2010** Agricultural machinery – Safety – Pick-up balers.

Over the next year or so the following safety standards should be introduced:

- **pr EN ISO 4254 – 14:2014?** Agricultural machinery – Safety – Baler wrappers;
- **pr ISO 4254 – 15:201?** Agricultural machinery – Safety – Large flail mowers.

## References

- [1] **Hawken K.**, 2010. Away from the Blade's edge. Conservation and harvesting equipment safety. In: ISO focus+, May 2010, 45-47



# Away from blade's edge

## Conservation and harvesting equipment safety

by Keith J. Hawken

Mowed fields and trimmed hedgerows are key for planting, growing and harvesting crops and for keeping our roads clear of encroaching vegetation. However, they are the result of hard work. Not just from those who physically toil and trim the earth's gardens and fields, but also from the standards developers working to ensure the safety of machinery used for these purposes.

Within ISO, the technical committee concerned is ISO/TC 23, *Tractors and machinery for agriculture and forestry*. More specifically, mowers and other similar tools are under the responsibility of ISO/TC 23 subcommittee SC 7, *Equipment for harvesting and conservation*.

SC 7's dedicated working groups focus on combine/forage harvesters, mower skirt protection and blade material, thrown object testing, large rotary and flail mower safety and body vibration issues. The subcommittee also looks at power harrows, seed drills, fertiliser spreaders, tedders/rakes, balers, and rotary/flail mowers.

### Better safe than sorry

General safety aspects of agricultural machinery are dealt by ISO/TC 23 subcommittee SC 3, *Safety and comfort*. However, SC 7 focuses on safety considerations specific to "implements" (tools towed behind a tractor) and trailers.

A key standard in this regard is ISO 4254, *Agricultural machinery – Safety*. The standard is divided into several parts, each focusing on a specific type of machinery. All of the machines mentioned above fall under its scope.

The following parts were published between 2008 and 2009:

- Part 5, *Power-driven soil-working machines*
- Part 7, *Combine harvesters, forage harvesters and cotton harvesters*
- Part 8, *Solid fertilizer distributors*
- Part 9, *Seed drills*
- Part 10, *Rotary tedders and rakes*.

Part 11 (pick – up balers) and Part 12 (rotary mowers and flail mowers) are at the final draft stage and publication is expected in the near future. Work is also progressing on Part 13 (large rotary mowers), which will include mowers with blade configurations enabling a cutting width of 14 metres.

A bale wrapper standard is also considered necessary to complement Part 11.

### From food production to motorway medians

Since SC 7 focuses principally on agricultural machinery, strengthening the food supply chain is one of its key goals. The subcommittee's numerous standards for combine/forage harvesters enable the



*Flail mower transverse preparation testing of thrown objects over stone and gravel composites.*

safe and efficient harvesting of grain and forage (plant leaves and stems) thus optimizing food production and helping farmers increase and maximize their yields.

Once SC 7 completed its work on combine/forage harvesters, it became clear that there was a pressing need to address “implement” machinery (equipment towed or trailed behind a tractor). So far, SC 7 efforts have targeted balers (farm machinery used to compress cut and raked crops into compact bales for easy handling and storage) through the development of ISO 4254-11, and mowers (machines for cutting crops or plants on the ground) through the upcoming ISO 4254-12.

*98 % of farm machinery injuries are caused by misuse and accidents.*

One of the challenges faced by SC 7 in this area has been the widening range of applications for mowing equipment. In addition to food production, hedge cutting machines have become vital for river banks, verges, median strips on motorways and farm hedgerows. This often requires that machines operate in roads and areas exposed to the general public, making bystanders vulnerable to related risks.

As more and more farmers and contractors require versatile machines for multiple operations, it is important that they clearly understand the constraints and correct usage of these products.

### Risky blades

Mowers, in particular, have been the subject of safety concerns in many countries. Mainly regarding the risk of objects being projected by the machine’s cutting units (referred to as “thrown objects”) and the blades themselves.

A stone or piece of wire ejected by a mower blade can achieve a velocity of more than 300 km/h, and travel as much as 200 metres. Around the world hundreds of thousands are injured annually by both field and lawn mowers. Serious accidents can result in lacerations, amputations and even death.

International Standards for safety testing are crucial to ensure that this risk is brought to a minimum, no matter where the machinery is manufactured, sold or operated. Testing institutes around the world have carried out hundreds of trials to improve safety, with an important focus of the work aiming to minimize thrown objects.

Such tests recreate surfaces encountered throughout the usage of the machine. Stones, steel parts (nail and wire) and wood are then placed on the mowers’ path. These tests help develop the most efficient defence to potential risks.

### International teamwork

The success of ISO/TC 23/SC 7’s work on equipment for harvesting and conservation is the result of concerted international effort to bring together best practice and create consensus.

The expertise of the European Committee for Standardization (CEN), whose own technical committees have addressed agricultural machinery, performance and highway/winter maintenance equipment has proved very useful. Similarly, the ISO member for the USA, who developed national standards in this area, also made an important contribution to the work.

Regarding thrown objects, testers in Italy and the USA have studied various surfaces and materials for ejected object simulation, and working group WG 9 within SC 7 is seeking to define the most appropriate approach. Members of WG 8 are conducting tests in Germany and the USA on blade material, while canvas skirt guarding is being examined in Italy for longevity and durability.

The development of large rotary mowers in WG 10 has benefited from valuable input from Mexico as the group grapples with the size of the machines.

Strong and growing producers of agricultural machinery, such as China and India, are encouraged to further engage in this work, as well as other countries with an interest in the subject.

However, the very nature of the machinery does not easily warrant a fully enclosed guard.

To address the issue, institutes in France, Germany, Italy, the United Kingdom and the USA came together to pool expertise and recommend a series of thrown object safety criteria. These recommendations are included in ISO 17101:2004, *Agricultural machinery – Rotary and flail mowers – Thrown-object test and acceptance criteria*, and are enhanced by ISO



Test site preparation for stone ejection testing of highway maintenance and agricultural machines and implements.

17103:2009, *Agricultural machinery – Rotary disc mowers, rotary drum mowers and flail mowers – Test methods and acceptance criteria for protective skirts.*

## More work remains

Although mower safety has been under development for over 35 years, as long as machines continue to change in sizes and requirements, work remains. After the ISO/TC 23/SC 7 plenary in Edinburgh, Scotland, in 2009, it was evident that the work schedule would increase because of machine innovation and complexity. SC 7 is currently developing testing criteria to revise ISO 5718:2002 (requirements of blades for agricultural rotary mowers) and to add a new part to ISO 17101.

Furthermore, accident statistics make it clear that, despite tremendous efforts to

design failsafe machinery, it is a continual and difficult task to shield users from all potential hazards.

*One of the challenges is the widening range of applications.*

Take the example of an individual fatally injured in Europe by a bale wrapper machine (complying only to generic standards and not those developed by SC 7) when he stood in an unauthorized position. Subsequent testing of this machine highlighted other variants that posed similar risks.

It was clear that SC 7 needed to address these hazards, which were not tackled by the scope of ISO 4254-11. Potential for

action includes a specific standard for the integral machinery or an amendment to Part 11, developed once independent testing is completed.

## Positive outlook

SC 7 are meeting in Pittsburgh, Pennsylvania, USA in June 2010, armed with a series of testing results and recommendations. Although farm machinery can be very dangerous, statistics indicate that 98% of injuries recorded in Europe and the USA are caused by misuse and pure accidental occurrence, with only 2% attributed to machine design. Still, SC 7 and the agricultural industry will continue to aim for the complete eradication of safety gaps.

Until then, the public in the countryside and on roadways can be assured that they are protected by improved requirements for specialist machinery now in place, product of SC 7's dedication to the safety of machinery within its remit, and to the conservation project it enables. ■

\* National Research Council (CNR) and The Institute for agricultural and earthmoving machines (IMAMOTER) Turin, with ISPEST (Italian National Institute for occupational safety and prevention).

## About the author



**Keith J. Hawken** with 27 years of experience on mowing equipment at Qualcast and Robert Bosch in the United Kingdom (UK), joined the Agricultural

Engineers Association (AEA) in 2000 to work on agricultural standards and legislation. He is Technical and Standards Director at AEA responsible for tractors, all terrain vehicles, sprayers, implements, telescopic handlers, and monitoring of European legislation as well as standards development for the UK trade association membership. He is Chair of four BSI (ISO member for the UK) committees and has been Chair of ISO/TC 23/SC 7 since 2007. Mr. Hawken is a Chartered Engineer (CEng) and holds the designation Eur Ing.



Comparison testing for mowers utilising different material surface and new criteria suggested for ISO 17101 revision.