

## Agriculture machinery: safety problems with power take-off (PTO) drive shafts and their guards

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The power take-off (PTO) drive shaft is a mechanical assembly generally used in agriculture for transferring mechanical power from a tractor to an operating machine. It allows spatial misalignment by means of two universal joints connected to each other by two telescopic elements. The harmonized standard EN 12965:2003+A2:2009 *Tractors and machinery for agriculture and forestry — Power take-off (PTO) drive shafts and their guards — safety* specifies safety requirements and their verification for the design and construction of power take-off (PTO) drive shafts and their guards linking a tractor or self-propelled machinery to the first fixed bearing of recipient machinery. It describes methods for the elimination or reduction of risks, which need specific requirements including such risks arising from misuse, reasonably foreseeable by the manufacturer. At present, the aforementioned standard is under revision considering also a specific request from Inail (Italian Institute for insurance against accidents at work). The reasons for Inail request are based on the significant number of accidents (most of them fatal) which occur when the operator moves toward the recipient machinery for some adjustment, while the PTO drive shaft is still rotating and its guards, the power input connection (PIC) guard or both are missing. The lack of the above-mentioned guards, mainly due to the difficulty for the operator to reach the locking system of the PTO drive shaft through the free space among the guards, exposes the operator to significant risks. Therefore, Italy brought the issue to the Machinery Directive Working Group, which gave mandate to CEN to solve it. Thus, the draft of the standard under revision has taken into account the possible entanglement due to an unprotected yoke by means of a specific test (entanglement test) and the opportunity to act on the PTO drive shaft locking system from outside the guards. However, the final draft of the revised standard still presents two main critical issues from Inail perspective:

1. with reference to locking system on PTO/PIC yoke, it is possible to reduce the risk of contact with moving parts by the overlapping of PTO drive shaft guard cone and tractor master shield and PIC guard, as usually done till today, or by means of a fully enclosed guard with external device for acting on the locking system. Thus, two different levels of safety are provided for the same risk;
2. it excludes from the entanglement test a clamp/flange type yoke, which is applied to a relevant number of PTO drive shafts. Thus, a significant risk of entanglement is not adequately assessed and reduced, even if there are technical solutions available.

