



**International
Standard**

ISO 5674

**Tractors and machinery for
agriculture and forestry — Guards
for power take-off (PTO) drive-
shafts — Strength and wear tests
and acceptance criteria**

*Tracteurs et matériels agricoles et forestiers — Protecteurs
d'arbres de transmission à cardans de prise de force (p.d.f)
— Essais de résistance mécanique et d'usure et critères
d'acceptation*

**Third edition
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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of 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 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 2, *Common tests*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 5674:2004), which has been technically revised.

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The main changes are as follows:

- the wording of [Annex B](#) line 8 has been clarified regarding “spectral irradiance”;
- the Type 4 Power Take-Off from ISO 500-1:2014 has been added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in the case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

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Tractors and machinery for agriculture and forestry — Guards for power take-off (PTO) drive-shafts — Strength and wear tests and acceptance criteria

1 Scope

This document specifies tests for determining the strength and wear resistance of guards for power take-off (PTO) drive-shafts on tractors and machinery used in agriculture and forestry, and their acceptance criteria. It is intended to be used in combination with ISO 5673-1:2005.

It is applicable to the testing of PTO drive-shaft guards and their restraining means. It is not applicable to the testing of guards designed and constructed to be used as steps.

This document is not applicable to guards for power take-off drive shafts that are manufactured before the date of publication of this document.

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 500-1:2014, *Agricultural tractors — Rear-mounted power take-off types 1, 2, 3 and 4 — Part 1: General specifications, safety requirements, dimensions for master shield and clearance zone*

ISO 4892-1:2016, *Plastics — Methods of exposure to laboratory light sources — Part 1: General guidance*

ISO 4892-2:2013, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-2:2013/Amd 1:2021, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps — Amendment 1: Classification of daylight filters*

ISO 5673-1:2005, *Agricultural tractors and machinery — Power take-off drive shafts and power-input connection — Part 1: General manufacturing and safety requirements*

ISO 105-A02:1993, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5673-1:2005 and the following apply.

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

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

3.1 minimum length

minimum distance that can be measured along the outside of the guard when held at its closed length

Note 1 to entry: For closed length, see ISO 5673-1:2005.

3.2

maximum length

maximum distance that can be measured along the outside of the guard when held at its extended length and bent through 90°

Note 1 to entry: For extended length, see ISO 5673-1:2005.

4 General test conditions

4.1 Guard

4.1.1 The guard shall be representative of a production model and be within the tolerances specified for the guard. The results obtained from the sample can be used to validate guards of shorter or longer lengths, provided the basic design remains the same. When a guard is designed for use with several drive shaft types, a representative selection of shaft and guard combinations shall be tested.

4.1.2 If the guard is made of plastic material (or any other material susceptible to degradation by UV radiation), it shall be validated to be resistant to degradation from UV radiation under an appropriate, recognized method in accordance with [Annex B](#).

4.1.3 During testing, all operating and maintenance instructions specified for the shaft and guard shall be complied with, except where specifically mentioned by this document.

4.1.4 The guard shall be tested in conjunction with a PTO drive shaft of between 900 mm and 1 010 mm closed length for which it is intended. The same guard shall be used throughout all the tests.

4.2 Other conditions

4.2.1 If specified in this document that the PTO drive shaft shall be rotating, its rotational frequency shall be 1 300 r/min for PTO drive shafts designed to be used for Type 4 PTO and 1 000 r/min for all other PTO drive shafts.

4.2.2 All tests shall be carried out in accordance with the schedule and in the sequence given in [Annex A](#).

4.2.3 All tests to be carried out at ambient temperature shall be carried out at temperature between 5°C and 35°C.

5 Test equipment

5.1 General

5.1.1 Wear test equipment shall be capable of holding the PTO drive shaft and rotating it at a frequency of 1 300 r/min for PTO drive shafts designed to be used for Type 4 PTO and 1 000 r/min for all other PTO drive shafts.

The shafts and guards shall be mounted as specified for operational use and only fixed by their designated restraining device. The fixing points shall be in accordance with ISO 500-1:2014 and the equivalent machine standard unless otherwise specified for that type of shaft. The size and shape of the wear test equipment shall be such that an even test environment is maintained, e.g. heat and the dust specified in [5.2.3](#).

5.1.2 Strength test equipment shall allow the application of known loads at controlled temperatures and at the required frequency of rotation within the tolerances stipulated in [Table 1](#).

5.2 Test parameters

5.2.1 Measuring accuracy

All measurements shall be within the tolerances given in [Table 1](#) except where otherwise required by this document.

Table 1 — Measuring accuracy

| | Measuring accuracy | Test tolerance |
|-------------------------|--------------------|----------------|
| Rotational speed | ±0,5 % | +5 % |
| Temperature | ±1,0 °C | ±5 % |
| Time | ±0,2 % | +5 % |
| Length | ±0,5 % | ±2 % |
| Force | ±1,0 % | +2 % |

5.2.2 Potable and salt water

5.2.2.1 When a test requires the use of water, it shall be potable (i.e. drinking water).

5.2.2.2 When a test requires a saltwater solution, it shall be prepared by dissolving sodium chloride in water to produce a concentration of 50 g/l ± 5 g/l. It shall not contain copper and nickel, and shall not contain more than 0,1 % of sodium iodine and not more than 0,4 % of total impurities calculated for dry salt.

5.2.3 Test dust

5.2.3.1 The test dust shall consist of a mixture composed of equal parts, by mass, of organic and mineral dust.

5.2.3.2 The organic dust shall be ground lucerne with a maximum percentage of 12 % water and with a maximum particle size of 2 mm. An environment of 0,5 kg/m³ shall be maintained.

5.2.3.3 The mineral dust shall be a simple phosphated fertilizer, and shall contain as principal elements silicophosphates of calcium having the following characteristics:

- minimum content: 9 % of P₂O₅ total (±3 %);
- other: at least 75 % of the P₂O₅ total declared, soluble in a 2 % concentration of citric acid.

See [Table 2](#).

Table 2 — Mineral dust specifications

| Mesh opening of sieve mm | Minimum fineness of grinding, after sifting % |
|-----------------------------|--|
| >0,063 | — |
| >0,125 | — |
| >0,16 | 75 |
| > 0,63 | 96 |

6 Tests

6.1 General

After each test, the condition of the guard shall be recorded, with particular reference to any fractures, permanent deformation or detachment of components which can contribute to the deterioration of the guard.

For the test sequence, see [Annex A](#).

The PTO drive shaft guard shall be deemed to have passed the test if

- the guard has no holes or deformation which leave the shaft unprotected,
- the guard has no breakage, crack or part separation, and
- the guard freely rotates separately from the PTO drive shaft when the PTO drive shaft is rotated.

Tests for a novel guard design are provided in [Annex D](#).

6.2 Wear test

6.2.1 For the whole test, the shaft shall be rotating and, while rotating, shall be extended to its extended length (see ISO 5673-1:2005), held for 1 min, then returned and held at its closed length (see ISO 5673-1:2005) for 4 min. This shall be repeated for the duration of the test period. See [Annex A](#) for the test sequence.

Guards shall only be fixed using the normal fixing and restraining system.

Before the start and at the end of each of the wear test cycles, the torque required for the immobilization of any part of the guard shall be measured, having first run the guard for 1 min. The torque measured shall not exceed 2,5 N·m per bearing race up to a maximum of 10 N·m per complete drive shaft.

6.2.2 At the start and at the end of the wear test, the running torque that needs to be applied to each guard tube in order to immobilize it shall be measured when the shaft is rotating at 1 300 r/min for PTO drive shafts designed to be used for Type 4 PTO and 1 000 r/min for all other PTO drive shafts.

6.2.3 For wear tests with dust, the test atmosphere shall contain 0,5 kg/m³ of dust according to [5.2.3](#).

6.3 Bearing corrosion test

IMPORTANT — This test is performed only if the guard has bearings running in contact with the PTO drive shaft.

Taking the shaft with the bearing in place, but with the rest of the guard removed, and supported horizontally and stationary, salt water (see [5.2.2.2](#)) shall be applied to all bearings for the first 5 min of every hour for 48 h, then shall be left to dry in free air (i.e. 48 cycles consisting of salt water application for 5 min of each cycle and drying in free air for the other 55 min of each cycle).

The salt water shall flow over all the metallic parts of the bearing system at some stage during the 5 min. No liquid shall be thrown off. The application of the salt water shall be carried out such that salt solution corrosion of its inner tubes is avoided.

6.4 Strength tests

6.4.1 Dynamic radial loading test at defined temperature limits

The guarded drive shaft shall be subjected to a radial loading test at ambient temperature after each complete cycle of the wear test (See [Annex A](#) and [D.8](#)).

The PTO drive shaft guard shall be deemed to have passed the test if

- the guard has no holes or deformation which leave the shaft unprotected, and
- the guard has no breakage, crack or part separation.

6.4.2 Test on guard component covering joints

The PTO drive shaft shall be rotated and, using a smooth, flat, 100 mm wide wooden beam, a direct force of 500 N shall be applied to the cone of the universal joint for 60 s, in accordance with [Annex A](#), perpendicularly to the PTO drive shaft.

To avoid excessive vibration, the wooden beam shall be supported by a 20 mm thick rubber backing of approximately A 20 Shore hardness. When applying the load, care shall be taken to ensure that no impact load is applied.

Test over every joint.

The PTO drive shaft guard shall be deemed to have passed the test if

- the guard has no holes or deformation which leave the shaft unprotected, and
- the guard has no breakage, crack or part separation.

6.4.3 Test on tubes

The guarded PTO drive shaft shall be supported in a horizontal, straight line by its usual end connections, at its extended length.

The PTO drive shaft shall be rotated and, using a smooth, flat, 100 mm wide wooden beam, a direct load of 500 N shall be applied for 60 s perpendicularly to the shaft guard at its midpoint, in accordance with [Annex A](#).

Whether any part of the rotating shaft was exposed during or after the test that allows a 30 mm probe to come into contact with that rotating part shall be recorded.

The PTO drive shaft guard shall be deemed to have passed the test if

- the guard has no holes or deformation which leave the shaft unprotected, and
- the guard has no breakage, crack or part separation.

6.4.4 Dynamic swivel test

The dimensions of the cone guarding the universal joints shall be such that the cone will not be damaged by contact with the master shield (see ISO 500-1:2014), when the drive shaft and guard are at the maximum allowable angle and while the shaft is rotating as specified in the instruction handbook.

If the guard cone does not come into contact with the master shield or any part of the drive shaft when the drive shaft is at the specified maximum rotating angular position, this test need not be carried out.

The following procedure shall be performed, with the PTO drive shaft rotating at 1 300 r/min for PTO drive shafts designed to be used for Type 4 PTO and 1 000 r/min for all other PTO drive shafts.

- Test the drive shafts with a nominal torque rating of <math><1\ 000\ \text{N}\cdot\text{m}</math> or a nominal transmitted power <math><57\ \text{kW}</math> at 540 r/min with the test master shield for PTOs of Types 1 and 2.
- Test the drive shafts with a higher nominal torque rating or nominal transmitted power with the test master shield for PTOs of Types 3 and 4.

The PTO drive shaft shall be coupled to a fixture with the test master shield integrated as shown in [Figure 1](#). The dimensions given in [Table 3](#) and the nominal torque shall be used.