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**Agricultural tractors — Test procedures —
Part 2: Hydraulic power and lifting capacity**

Tracteurs agricoles — Méthodes d'essai — Partie 2: Puissance hydraulique et capacité de relevage

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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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 789/2 was developed by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*. The first edition (ISO 789/2-1979) had been approved by the member bodies of the following countries:

Australia	Germany, F.R.	Romania
Austria	India	South Africa, Rep. of
Belgium	Iran	Spain
Brazil	Ireland	Sweden
Bulgaria	Italy	Switzerland
Canada	Korea, Dem. P. Rep. of	Turkey
Chile	Mexico	United Kingdom
Czechoslovakia	Netherlands	USA
Denmark	New Zealand	USSR
Finland	Philippines	Yugoslavia
France	Poland	

No member body had expressed disapproval of the document.

This second edition, which cancels and replaces ISO 789/2-1979, incorporates draft Amendment 1, which was circulated to the member bodies in January 1982 and has been approved by the member bodies of the following countries:

Australia	Germany, F.R.	Romania
Austria	India	South Africa, Rep. of
Belgium	Iraq	Spain
Brazil	Italy	Sweden
Canada	Korea, Dem. P. Rep. of	Switzerland
China	Korea, Rep. of	Turkey
Czechoslovakia	Mexico	United Kingdom
Egypt, Arab Rep. of	New Zealand	USA
Finland	Poland	USSR
France	Portugal	

No member body expressed disapproval of the document.

Agricultural tractors — Test procedures — Part 2: Hydraulic power and lifting capacity

0 Introduction

This part of ISO 789 forms part of a series covering test procedures for agricultural tractors. Other parts in the series will be as follows:

Part 1: Power tests.

Part 3: Turning space/turning circle.

Part 4: Exhaust smoke measurement.

Part 5: Partial power p.t.o. — Non-mechanically transmitted power.

Part 6: Centre of gravity.

Part 7: Power and torque of the drive wheels.

Part 8: Engine air cleaner.

1 Scope and field of application

This part of ISO 789 specifies test procedures for determining the following hydraulic performance characteristics of agricultural tractors:

- a) the maximum vertical force which can be exerted by the hydraulic lift at the lower hitch points throughout their full range of movement;
- b) the maximum vertical force which can be exerted by the hydraulic lift, at a point 610 mm to the rear of the hitch points on a frame attached to the three-point linkage, throughout its full range of movement;

c) the maximum hydraulic power available at an external hydraulic tapping;

d) optionally, the ability of the lifting system to maintain the load in the lifted position without hydraulic power.

NOTE — To ensure that the lifting capacity and the hydraulic power are adequate for effective practical use and also to allow for variation in the performance of nominally identical tractors, the measured maximum performance is reported as that which would be obtained with the hydraulic fluid pressure maintained at 90 % of the pressure sustained by the relief valve (see 5.1.3.4).

2 References

ISO 730/1, *Agricultural wheeled tractors — Three-point linkage — Part 1: Categories 1, 2 and 3.*

ISO 730/2, *Agricultural wheeled tractors — Three-point linkage — Part 2: Category 1 N (Narrow hitch).*

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification.*

3 Definitions

3.1 agricultural tractor: A self-propelled wheeled, track-laying or semi-track-laying machine, more particularly designed to pull, push, carry and operate all implements used for agricultural work (including forestry work). It may be provided with a detachable loading platform.¹⁾

1) Definition taken from ISO 3339/1 (in preparation).

3.2 rated engine speed: The maximum rotational frequency, in reciprocal minutes (min^{-1}), specified by the tractor manufacturer for continuous operation at full load.

4 Test conditions

4.1 The tractor tested shall conform to the specification in the test report and shall be used in accordance with the manufacturer's recommendations for normal operation.

4.2 The tractor shall be run-in prior to the test. For spark ignition engines fitted with a means for the operator to vary the ratio of the fuel/air mixture, the tests shall be carried out with the settings recommended for normal operation.

4.3 The hydraulic fluid shall be as recommended by the manufacturer and identified by type and viscosity (see ISO 3448).

4.4 The throttle or governor control lever shall be adjusted to maintain the rated engine speed except where otherwise specified.

4.5 At the start of each test the temperature of the hydraulic fluid in the tank shall be measured and shall be 65 ± 5 °C. If this cannot be achieved, owing to the presence of an oil cooler for example, the temperature measured during the test shall be stated in the test report.

4.6 A pressure gauge shall be fitted immediately next to the external tapping of the tractor.

4.7 The accuracy of measurements shall be as follows:

Rotational frequency:	$\pm 0,5$ %
Distance:	$\pm 0,5$ %
Force:	$\pm 1,0$ %
Mass:	$\pm 0,5$ %
Pressure:	± 2 %
Temperature:	$\pm 0,5$ °C

5 Test procedures

5.1 Hydraulic lifting test

5.1.1 General

5.1.1.1 The unballasted tractor shall be so secured in a horizontal position that the tyres are not deflected by the reactive force of the power lift.

5.1.1.2 The linkage shall be adjusted, as appropriate for the tests with or without the coupled frame, to achieve typical and repeatable arrangements as follows :

5.1.1.2.1 The linkage shall be adjusted in such a way as to achieve the power range required in ISO 730/1 or ISO 730/2 and a height of the lower hitch points, in the lowered position of 200 mm (categories 1, 1 N and 2), and respectively 230 mm (category 3) above ground level. For those tractors which do not achieve the standard power range, the lifting force will be measured at the maximum achievable power range.

5.1.1.2.2 The upper link shall be adjusted to the length necessary to bring the mast hitch point to a position when the lower links are horizontal.

5.1.1.2.3 Where more than one upper or lower link point is available on the tractor, the points used shall be those specified by the manufacturer and shall be included in the test report.

5.1.1.2.4 Where there is more than one point attachment to connect the lift rod to the lower links, the connection points used shall be those specified by the manufacturer and shall be included in the test report.

5.1.1.2.5 These initial adjustments, as far as possible, shall cause the mast to rotate through a minimum of 10° over the full range of lift. If this is not possible, the fact shall be stated in the test report.

5.1.2 Lift at the lower hitch points

5.1.2.1 An external vertical downward force shall be applied to a horizontal bar connecting the hitch points. This force, which shall be capable of being measured, shall lie in the central longitudinal plane of the tractor and shall be maintained vertical throughout the lift range.

NOTE — Care should be taken to avoid torsional components in this force, which can affect the accuracy of measurements.

5.1.2.2 The lifting force available and the corresponding pressure of the hydraulic fluid shall be determined at a minimum of six points approximately equally spaced throughout the range of movement of the lift, including one at each extremity. At each point the force shall be the maximum which can be exerted against a static load. Additionally, the range of movement shall be measured.

5.1.2.3 The minimum of the lifting loads shall be corrected to a force corresponding to a hydraulic pressure equivalent to 90 % of the minimum relief valve pressure setting specified by the manufacturer. The corrected value shall constitute the maximum vertical force which can be supported by the hydraulic lift throughout its full range of movement.

NOTE — Lifting force is presumed to be directly proportional to pressure.

5.1.3 Lift on a coupled frame

5.1.3.1 A frame having the following characteristics shall be attached to the three-point linkage.

5.1.3.1.1 The mast height and the distance from the hitch points to the centre line of the tractor shall be appropriate to

the linkage category of the tractor as specified in ISO 730/1 or ISO 730/2. Where more than one category is specified, that chosen for the test shall be at the manufacturer's option.

5.1.3.1.2 The centre of gravity shall be at a point 610 mm to the rear of the hitch points, on a line at right angles to the mast upper hitch point and passing through the middle of the line joining the lower hitch points.

5.1.3.2 An external, downward vertical force, which shall be capable of being measured, shall be applied to the frame at the centre of gravity and the weight of the frame shall be added to it to obtain the lifting force.

5.1.3.3 The lifting load available and the corresponding pressure of the hydraulic fluid shall be determined at a minimum of six points approximately equally spaced throughout the range of movement of the lift, including one at each extremity. At each point the force shall be the maximum which can be supported against a static load. Additionally, the range of movement shall be measured.

5.1.3.4 The minimum of the lifting loads shall be corrected to that corresponding to a hydraulic pressure equivalent to 90 % of the minimum relief valve pressure setting specified by the manufacturer. The corrected value shall constitute the maximum vertical force which can be supported by the hydraulic lift throughout its full range of movement.

5.1.4 Report

The following shall be reported:

- a) the maximum corrected vertical forces at the hitch points (see 5.1.2.3) and at the centre of gravity of the frame (see 5.1.3.4);
- b) the full range of vertical movement of the respective points of application of the force (see 5.1.2.2 and 5.1.3.3);
- c) the pressure equivalent in kilopascals to 90 % of the minimum relief valve pressure setting as specified by the manufacturer;
- d) the height in millimetres of the lower hitch point above the ground in its lowermost position and without load;
- e) the angle through which the mast rotates over the full range of lift;
- f) the main linkage dimensions in millimetres including the mast height of the frame, as tested, relative to the centre of the rear wheels (on a drawing);
- g) the temperature of the hydraulic fluid at the start of each test in degrees Celsius;
- h) the calculated moment around the rear axle, in newton metres, resulting from the maximum external lift force at the frame which can be exerted through the full range of movement.

5.2 Hydraulic power test

The following measurements shall be reported:

- a) the opening pressure of the relief valve or, if this is impossible to measure, the manufacturer's setting;
- b) the pressure sustained by the open relief valve, with the pump stalled in the case of a closed-centre system with pressure-compensated variable delivery pump;
- c) the opening and closing pressures of the unloading valve in the case of a closed-centre system having an accumulator;
- d) the pump delivery rate, in litres per second, using a designated auxiliary service coupling, as determined with measuring equipment causing negligible pressure drop in the external line;
- e) the hydraulic power, in kilowatts, available at the designated auxiliary service coupling and at the corresponding flow rate, at 90 % of the relief valve pressure;
- f) the hydraulic power, in kilowatts, available at the designated auxiliary service coupling, at a pressure and a flow specified by the manufacturer for continuous operation of an external hydraulic motor. The pressure shall not exceed 90 % of the minimum specified relief valve pressure.

5.3 Maintenance of lift of load

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<https://standards.itech.ai/catalog/standards/siv/55508d4e-191c48-7bbaefbc121f/iso-789-2-1983> NOTE 5 The test is optional at the request of the manufacturer.

5.3.1 The tractor shall be secured in accordance with 5.1.1.

5.3.2 A downward vertical force equal to 90 % of the maximum force which can be exerted throughout the full range of movement (see 5.1.6) shall be applied to the frame at its centre of gravity.

5.3.3 With the hydraulic lift in its uppermost position and the control lever in the "raise" position, the engine shall be stopped and the vertical height of the point of application of the force shall be measured.

5.3.4 At intervals of 5 min over a period of 30 min, the vertical height shall be remeasured.

5.3.5 The following measurements shall be reported:

- a) the force applied to the frame;
- b) the decrease in the height of the point of application of the force after each 5 min interval;
- c) the ambient temperature at the start of measuring.

6 Test report

A suitable test report is shown in the annex.

Annex

Specimen test report

Tractor manufacturer's name and address:

Date and location of tests:

Specification of tractor

Tractor:

Model: Serial No.:

Mass with tanks full but without ballast or driver: kg

Engine:

Make: Model:

Type: Serial No.:

Rated engine speed: ^{ISO 789-2:1983} (min⁻¹)
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Hydraulic fluid used in tests

Type: Viscosity: cSt¹⁾

Viscosity index:

Type of the hydraulic system:

1) 1 cSt = 1 mm²/s

Hydraulic lifting test
(see 5.1)

	Height of lower hitch point above ground in down position mm	Vertical movement mm	Maximum force exerted through full range kN	Pressure kPa	Moment about rear axle kN-m	Tilt angle of mast over range of lift degrees
At hitch points						
On the frame						

Temperature of hydraulic fluid: °C
Main linkage dimensions (as tested) — see attached drawing.

Hydraulic power test
(see 5.2)

Opening pressure of the relief valve: kPa
(or manufacturer's setting if opening pressure cannot be measured)

Sustained pressure with relief valve open: kPa
(Pump stalled — yes/no)

Opening pressure of the unloading valve: kPa

Closing pressure of the unloading valve: kPa

Pump delivery rate at minimum pressure and rated engine speed: l/min

Hydraulic power at 90 % of relief valve setting or at kPa: kW

Pressure specified by the manufacturer for an external hydraulic motor: kPa

Tapping point:

Pump delivery rate at stated power: l/min

Pressure at maximum power: kPa

Temperature of hydraulic fluid: °C

Maintenance of lift of load
(see 5.3)

Force applied to frame: kN

Ambient temperature at the start of measuring: °C

Time, min	5	10	15	20	25	30
Lowering, mm						

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