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**789-2**

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**Agricultural tractors — Test procedures —**  
**Part 2:**  
Rear three-point linkage lifting capacity

*Tracteurs agricoles — Méthodes d'essai —*

*Partie 2: Capacité de relevage de l'attelage trois points arrière*



## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 789-2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Sub-Committee SC 2, *Common tests*.

ISO 789 consists of the following parts, under the general title *Agricultural tractors — Test procedures*:

- *Part 1: Power tests for power take-off*
- *Part 2: Rear three-point linkage lifting capacity*
- *Part 3. Turning and clearance diameters*
- *Part 4: Measurement of exhaust smoke*
- *Part 5: Partial power PTO — Non-mechanically transmitted power*
- *Part 6: Centre of gravity*
- *Part 7: Axle power determination*
- *Part 8: Engine air cleaner*
- *Part 9: Power tests for drawbar*

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— *Part 10: Measurement of hydraulic power — Tractor/implement interface*

— *Part 11: Steering capability — Wheeled tractors*

Annex A forms an integral part of this part of ISO 789.



# Agricultural tractors — Test procedures —

## Part 2:

## Rear three-point linkage lifting capacity

### 1 Scope

This part of ISO 789 specifies test procedures for determining the lifting capacity of rear-mounted three-point linkage systems:

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

#### NOTES

1 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 6.1.3 4).

2 A static test provides an adequate comparison between tractors. It should be recognized that the test results are to be used only as a means of comparing tractors and not as a way of recommending the size of an implement which can be carried by the tractor.

### 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions

of this part of ISO 789. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 789 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 730-1:1990, *Agricultural wheeled tractors — Rear-mounted three-point linkage — Part 1: Categories 1, 2 and 3.*

ISO 730-2:1979, *Agricultural wheeled tractors — Three-point linkage — Part 2: Category 1 N (Narrow hitch).*

ISO 730-3:1982, *Agricultural wheeled tractors — Three-point linkage — Part 3: Category 4.*

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification.*

### 3 Definitions

For the purposes of this part of ISO 789, the following definitions apply.

**3.1 agricultural tractor:** Self-propelled wheeled machine having at least two axles, or a track-laying machine, particularly designed to pull, push, carry and operate implements used for agricultural work (including forestry work), which may be provided with a detachable loading platform.

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

## 4 Measurement units and tolerances

The following units and tolerances are used in this part of ISO 789:

- a) rotational frequency, in revolutions per minute:  $\pm 0,5 \%$
- b) time, in seconds:  $\pm 0,2 \text{ s}$
- c) distance, in metres or millimetres:  $\pm 0,5 \%$
- d) force, in newtons:  $\pm 1 \%$
- e) mass, in kilograms:  $\pm 0,5 \%$
- f) pressure, in kilopascals:  $\pm 2 \%$
- g) temperature, in degrees Celsius:  $\pm 0,5 \text{ }^\circ\text{C}$

## 5 General requirements

### 5.1 Specifications

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

### 5.2 Running-in and preliminary adjustments

**5.2.1** The tractor shall be run-in prior to the test.

**5.2.2** The hydraulic fluid shall be as recommended by the manufacturer and identified by type and viscosity in accordance with ISO 3448.

**5.2.3** The throttle or governor control lever shall be set for maximum speed.

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

### 5.3 Requirements during test

**5.3.1** At the start of each test the temperature of the hydraulic fluid in the tank shall be measured; it shall be  $65 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ . 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.

**5.3.2** The ambient temperature during the test shall be  $23 \text{ }^\circ\text{C} \pm 7 \text{ }^\circ\text{C}$ .

## 6 Test procedures

### 6.1 Hydraulic lifting test

#### 6.1.1 General

**6.1.1.1** Secure the unballasted tractor in a horizontal position such that the tyres are not deflected by the reactive force of the power lift.

**6.1.1.2** Adjust the linkage, as appropriate for the tests with or without the coupled frame, to achieve typical and repeatable arrangements as specified in 6.1.1.2.1 to 6.1.1.2.5.

**6.1.1.2.1** The linkage shall be adjusted in such a way as to achieve the power range and lower hitch point height as specified in ISO 730-1, ISO 730-2 or ISO 730-3. For those tractors which do not achieve the standard power range, measure the lifting force at the maximum achievable power range. If the tractor cannot achieve the specified power range and lower hitch point height, the fact shall be stated in the test report.

**6.1.1.2.2** The upper link shall be adjusted to the length necessary to bring the mast of the frame vertical when the lower links are horizontal.

**6.1.1.2.3** 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 stated in the test report.

**6.1.1.2.4** 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 stated in the test report.

**6.1.1.2.5** These initial adjustments, as far as possible, shall cause the mast to rotate through a minimum of  $10^\circ$  from the vertical to the angle at which the frame is in the uppermost position. If this is not possible, the fact shall be stated in the test report.

#### 6.1.2 Lift at lower hitch points

**6.1.2.1** Apply an external vertical downward force 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.

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

**6.1.2.2** Determine the lifting force available and the corresponding pressure of the hydraulic fluid at a minimum of six points approximately equally spaced throughout the range of movement of the lift, includ-

ing one at each extremity. At each point the force shall be the maximum which can be exerted against a static load. Additionally, measure the range of movement.

The pressure recorded during the test shall exceed the minimum relief valve pressure setting.

**6.1.2.3** Correct the minimum of the lifting loads to a force corresponding to a hydraulic pressure equivalent to 90 % of the minimum relief valve pressure setting of the hydraulic lift system. The corrected value constitutes the maximum vertical force which can be supported by the hydraulic lift throughout its full range of movement.

NOTE 3 Lifting force is presumed to be directly proportional to pressure.

### 6.1.3 Lift on coupled frame

**6.1.3.1** Attach a frame having the following characteristics to the three-point linkage.

- a) The mast height and the distance from the hitch points to the centreline of the tractor shall be appropriate to the linkage category of the tractor as specified in ISO 730-1, ISO 730-2 or ISO 730-3. Where more than one category is specified, that chosen for the test shall be at the manufacturer's option.
- b) 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 and passing through the middle of the line joining the lower hitch points.

**6.1.3.2** Apply an external vertical downward force, which shall be capable of being measured, to the frame at the centre of gravity and add the weight of the frame to it to obtain the lifting force.

**6.1.3.3** Determine the lifting load available and the corresponding pressure of the hydraulic fluid 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, measure the range of movement.

The pressure recorded during the test shall exceed the minimum relief valve pressure setting.

**6.1.3.4** Correct the minimum of the lifting loads to that corresponding to a hydraulic pressure equivalent to 90 % of the minimum relief valve pressure setting of the hydraulic lift system. The corrected value con-

stitutes the maximum vertical force which can be supported by the hydraulic lift throughout its full range of movement.

### 6.1.4 Report

The following shall be reported:

- a) the maximum corrected vertical forces at the hitch points (see 6.1.2.3) and at the centre of gravity of the frame (see 6.1.3.4), as a function of the lifting heights measured with respect to the horizontal lower links for the whole range of movement of the lift;
- b) the full range of vertical movement of the respective points of application of the force (see 6.1.2.2 and 6.1.3.3);
- c) the pressure in kilopascals equivalent to 90 % of the minimum relief valve pressure setting of the hydraulic lift system;
- 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 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.

NOTE 4 A suitable test report form is shown in annex A.

## 6.2 Maintenance of lift of load test

NOTE 5 This test is optional at the request of the manufacturer.

**6.2.1** Secure the tractor in accordance with 6.1.1.

**6.2.2** Apply a downward vertical force equal to the maximum vertical force which can be supported by the hydraulic lift throughout the full range of movement (see 6.1.3) to the frame at its centre of gravity and maintain it throughout the test.

**6.2.3** With the hydraulic lift and its controls in the positions recommended by the manufacturer for transport of mounted implements, stop the engine and measure the vertical height of the point of application of the force.

**6.2.4** At intervals of 5 min over a period of 30 min remeasure the vertical height.

**6.2.5** 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.



## Annex A (normative)

### Specimen test report for three-point hitch lift capacity

#### A.1 Locations

Tractor manufacturer's name and address: .....

.....

.....

Date and location of tests: .....

#### A.2 Specification of tractor

##### Tractor

Model: ..... Serial No.: .....

Mass with tanks full but without ballast or driver: ..... kg

##### Engine

Make: ..... Model: .....

Type: ..... Serial No.: .....

Rated speed: .. min<sup>-1</sup>

##### Hydraulic fluid used in tests

Type: ..... Viscosity: ..... mm<sup>2</sup>/s

NOTE 6 1 mm<sup>2</sup>/s = 1 cSt

Viscosity index: .....

Type of hydraulic system: .....

#### A.3 Hydraulic lifting test (see 6.1)

	Height of lower hitch point above ground in down position mm	Vertical movement mm	Maximum force exerted through full range kN	Pressure <sup>1)</sup> kPa	Moment about rear axle kN·m	Tilt angle of mast over range of lift degrees
At hitch points						
On frame						

1) 90 % of minimum relief valve pressure setting.





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**Descriptors:** agricultural machinery, agricultural tractors, rear part, couplings, tests, determination, lifting forces, mechanical power measurement, testing conditions

