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Agricultural tractors — Test procedures — Part 10: Hydraulic power at tractor/implement interface

Tracteurs agricoles — Méthodes d'essai —

Partie 10: Puissance hydraulique disponible à la liaison tracteur/instrument



Reference number
ISO 789-10:1996(E)

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 789-10 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee 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
- Part 10: Hydraulic power at tractor/implement interface

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— *Part 11: Steering capability of wheeled tractors*

— *Part 12: Low temperature starting*

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

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Agricultural tractors — Test procedures —

Part 10:

Hydraulic power at tractor/implement interface

1 Scope

This part of ISO 789 specifies the test procedure for determining the hydraulic pressures at the external hydraulic service as specified in ISO 10448. A companion test procedure is included for measuring the maximum hydraulic power available.

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 730-1:1994, *Agricultural wheeled tractors — Rear-mounted three-point linkage — Part 1: Categories 1, 2, 3 and 4*.

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

ISO 5675:1992, *Agricultural tractors and machinery — General purpose quick-action hydraulic couplers*.

ISO 6149-1:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261 threads and O-ring sealing — Part 1: Ports with O-ring seal in truncated housing*.

ISO 6149-2:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261*

threads and O-ring sealing — Part 2: Heavy-duty (S series) stud ends — Dimensions, design, test methods and requirements.

ISO 6149-3:1993, *Connections for fluid power and general use — Ports and stud ends with ISO 261 threads and O-ring sealing — Part 3: Light-duty (L series) stud ends — Dimensions, design, test methods and requirements*.

ISO 10448:1994, *Agricultural tractors — Hydraulic pressure for implements*.

3 Definitions

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

3.1 agricultural tractor: Self-propelled machine, either wheeled having at least two axles or track-laying, particularly designed to pull, push, carry and operate implements used for agricultural work (including forestry work).

NOTE 1 It may be provided with a detachable loading platform.

3.2 rated engine speed: Engine speed specified by the tractor manufacturer for continuous operation at full load.

3.3 external hydraulic service: Source of hydraulic power, derived from the hydraulic system of the agricultural tractor, available for use on an implement mounted on, coupled to or otherwise used in conjunction with it. [ISO 10448:1994]

3.4 coupler pair: Pair of female hydraulic couplers compatible with male couplers specified in ISO 5675, mounted on agricultural tractors and connected to the hydraulic system to allow flow from one coupler to the other. [ISO 10448:1994]

3.5 available differential pressure: Steady state difference in hydraulic pressure between two male coupler parts on the implement side. [ISO 10448:1994]

3.6 maximum pressure: Maximum steady state hydraulic pressure at either male coupler connected to a coupler pair. [ISO 10448:1994]

3.7 maximum loop return pressure: Maximum steady hydraulic pressure at the male coupler returning flow to a hydraulic system that can reverse the flow through that coupler. [ISO 10448:1994]

3.8 maximum sump return pressure

(1) With coupler: Maximum steady state hydraulic pressure at the male coupler returning flow directly to the reservoir.

(2) Without coupler: Maximum steady state hydraulic pressure at an M22 × 1,5 or M27 × 2 thread size port in accordance with ISO 6149-1, ISO 6149-2 or ISO 6149-3, returning flow directly to the reservoir.

[ISO 10448:1994]

3.9 rated maximum hydraulic pressure: Maximum pressure as specified by the tractor manufacturer.

3.10 peak pressure: Maximum instantaneous hydraulic pressure at either male coupler connected to a coupler pair. [ISO 10448:1994]

4 Measurement units and tolerances

The following units and tolerances, applicable to the maximum value measured, 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) temperature, in degrees Celsius: $\pm 2 \text{ }^{\circ}\text{C}$ (applicable to actual readings)
- d) pressure, in megapascals: $\pm 0,002 \%$
- e) flow, in litres per minute: $\pm 2 \%$

5 General requirements

5.1 Specification

The tractor tested shall have its specification given 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 adjusted to maintain the rated engine speed. However, in those cases where the manufacturer prefers to carry out specific portions of the test at other engine speeds, the test engine speed shall be continuously recorded.

5.2.4 At the start of each test, the temperature of the hydraulic fluid in the tractor hydraulic reservoir shall be at $65 \text{ }^{\circ}\text{C} \pm 5 \text{ }^{\circ}\text{C}$ and be recorded. If this cannot be achieved, due to the presence of an oil cooler or other system component, the temperature measured during the test shall be stated in the test report.

5.2.5 All tractor-mounted flow controls shall be adjusted to obtain maximum flow.

6 Available hydraulic pressure test

6.1 Steady state

6.1.1 Test conditions

The test conditions for determining maximum pressure, minimum available differential pressure, maximum loop return pressure and sump return pressure are as follows.

- a) A test assembly shall be looped between a coupler pair. The test assembly shall consist of a minimum 10 mm inside diameter hose test assembly with male couplers conforming to ISO 5675 size 12,5 at each end and including two pressure gauges located respectively immediately next to each coupler, a flow meter and an adjustable restrictor valve which is used to vary flowrate. (See figure 1.)

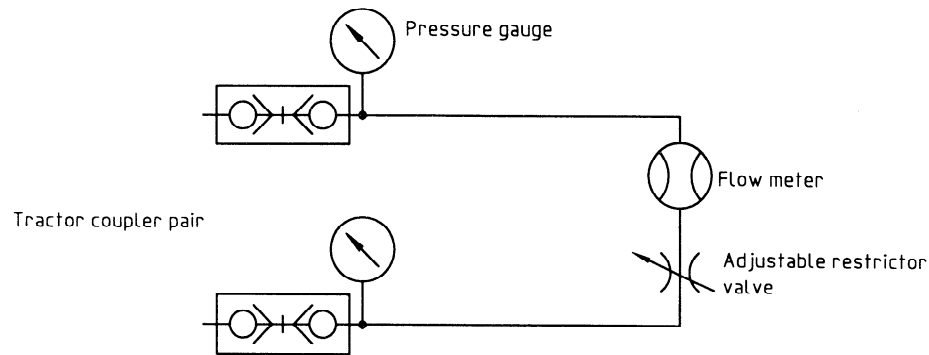


Figure 1 — Steady state test assembly

- b) When determining the maximum sump return pressure with coupler, one end of the test assembly shall be connected to a coupler that is connected directly to the tractor reservoir or to the sump return port as specified by the manufacturer and the other to one half of a coupler pair.
- c) When determining the maximum sump return pressure without coupler, the test assembly shall be changed by removing the coupler from the sump return end and replacing it with suitable adapters to connect directly to the sump return port.

6.1.2 Test procedure

6.1.2.1 Flow through single coupler pair

Actuate the tractor external hydraulic service to route oil through the test assembly. Adjust the adjustable restrictor valve or engine speed to produce the standard flow of 30 l/min for category 1 tractors and 50 l/min for category 2 or 3 tractors, as specified in ISO 730-1. Record the pressure near the coupler where oil is exiting from the tractor, the pressure near the coupler where oil is reentering the tractor, oil flow and reservoir oil temperature. Maximum loop return pressure (see 3.7) is the pressure near the coupler where oil is entering the tractor.

Calculate the available differential pressure by subtracting the pressure of oil reentering the tractor from the pressure of oil exiting the tractor.

Close the adjustable restrictor valve. Record the pressure near the coupler where oil is exiting from the tractor to determine the maximum pressure.

6.1.2.2 Flow into sump return port with coupler

Actuate the tractor external hydraulic service to route oil through the test assembly. Adjust the adjustable

restrictor valve or engine speed to produce the standard flow of 30 l/min for category 1 tractors, or 50 l/min for category 2 or 3 tractors, as specified in ISO 730-1. Record the pressure near the coupler where oil is exiting from the tractor, the pressure near the coupler where oil is reentering the tractor, oil flow and reservoir oil temperature.

6.1.2.3 Flow into sump return port without coupler

Actuate the tractor external hydraulic service to route oil through the test assembly. Adjust the adjustable restrictor valve or engine speed to produce the standard flow of 30 l/min for category 1 tractors, or 50 l/min for category 2 or 3 tractors, as specified in ISO 730-1. Record the pressure near the coupler where oil is exiting from the tractor, the pressure near the coupler where oil is reentering the tractor, oil flow and reservoir oil temperature.

6.2 Peak pressure

6.2.1 Test conditions

The peak pressure shall be determined using a test assembly which is looped between a coupler pair (see figure 2). The test assembly shall consist of a double-acting cylinder without a cushion, and a pair of 2 500 mm $\pm$ 100 mm long sections of nominal 10 mm inside diameter hydraulic hose with male couplers conforming to ISO 5675 size 12,5 at each end. The cylinder dimensions shall be 80 mm $\pm$ 5 mm bore, 30 mm $\pm$ 5 mm rod and 200 mm $\pm$ 10 mm stroke. A pressure transducer and recording equipment capable of indicating a pressure rise rate of 700 MPa/s shall be connected within 100 mm of each male coupler connecting the hydraulic cylinder to the tractor.

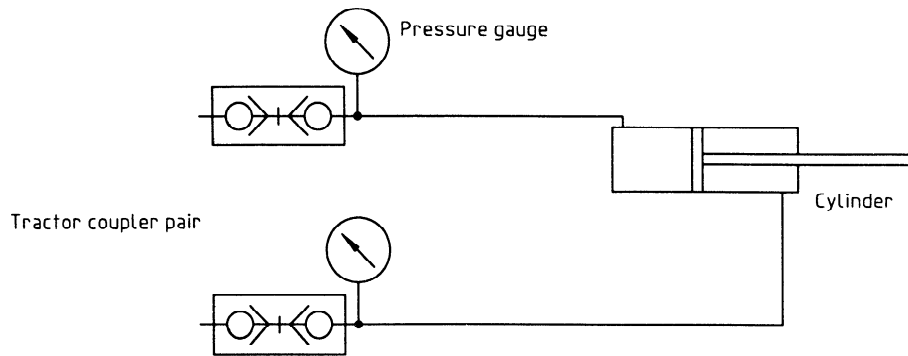


Figure 2 — Peak pressure test assembly

6.2.2 Test procedure

Actuate the tractor external hydraulic service to extend and retract the cylinder fully a total of 15 complete cycles.

Record the maximum pressure observed during the cylinder extended portion of 15 cycles of cylinder movement as "peak pressure".

6.3 Test report of available hydraulic pressure

A suitable test report form is shown in annex A. The test report shall include the following information:

- the maximum pressure and peak pressure;
- the available differential pressure using a single coupler pair for the standard flow of 30 l/min for category 1 tractors or 50 l/min for category 2 or 3 tractors;
- the maximum loop return pressure;
- the maximum sump return pressure with or without coupler;
- the minimum and maximum observed temperatures, representing the range of oil temperatures.

7 Maximum available hydraulic power test

7.1 Test conditions

The test conditions for measuring maximum available hydraulic power are as follows.

- A test assembly shall be looped between a coupler pair or coupler pairs. This test assembly shall consist of a nominal 12 mm inside diameter hose, with male couplers conforming to ISO 5675 size 12,5 at each end, two pressure gauges located respectively within 100 mm of each coupler, an adjustable restrictor valve and a flow meter (see figure 3). The adjustable restrictor valve in fully open position and the flow meter shall have a combined pressure drop of less than 0,2 MPa at 60 l/min.
- If hydraulic power from all coupler pairs is to be measured, a second set of male couplers shall be provided in parallel (see figure 3).

7.2 Test procedures

7.2.1 Maximum available hydraulic power through single coupler pair

Actuate the external hydraulic service to route oil through the test assembly. Adjust the adjustable restrictor valve slowly from fully open to fully closed while recording simultaneous values of pressure, at the two locations, and flow. If continuous recording equipment is not used, the adjustable restrictor valve should be adjusted in increments sufficiently small to determine the maximum available hydraulic power.

The available hydraulic power, P , in kilowatts, from a single coupler pair is calculated by the following formula:

$$P = \frac{(p_1 - p_2) \times q}{60}$$

where

- p_1 is the pressure, in megapascals, near the coupler where oil is exiting the tractor;

p_2 is the pressure, in megapascals, near the coupler where oil is reentering the tractor;

q is the measured flow, in litres per minute.

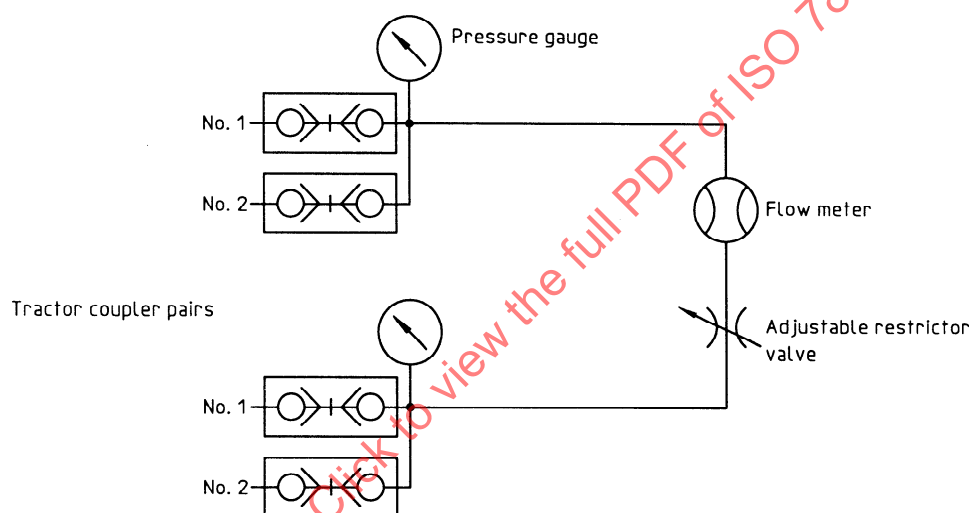
7.2.2 Maximum available hydraulic power through simultaneous use of all coupler pairs

With the test assembly connected to all coupler pairs, actuate all tractor external hydraulic services to route oil through the test assembly. Complete the remainder of the test as in 7.2.1.

7.3 Report of available hydraulic power

A suitable test report form is shown in annex A. The test report shall include the following information:

- the flowrate with the adjustable restrictor valve fully open for one coupler pair and all coupler pairs in simultaneous operation;
- the maximum hydraulic power available, and the corresponding flow and available differential pressure for one coupler pair, and for two coupler pairs in simultaneous operation.



Connection is made to No. 1 coupler pair only when testing hydraulic power available from one coupler pair.

Connection is made to both No. 1 and No. 2 or more coupler pairs when testing hydraulic power available from all coupler pairs.

Figure 3 — Maximum hydraulic power test assembly