INTERNATIONAL STANDARD

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Agricultural tractors — Test procedures —

Part 10: Hydraulic power at tractor/implement interface

Tracteurs agricoles — Modes opératoires d'essai —

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

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

ISO/OECD 789-10 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests*, in cooperation with the Organisation for Economic Cooperation and Development (OECD).

This first edition of ISO/OECD 789-10 cancels and replaces ISO 789-10:1996, which has been technically revised.

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* [joint publication with OECD]

— *Part 11: Steering capability of wheeled tractors*

— *Part 12: Low temperature starting*

Rear three-point linkage lifting capacity is to form the subject of a future ISO/OECD 789-2.

Foreword

OECD (the Organisation for Economic Cooperation and Development) is an intergovernmental reference for the certification and standardization of certain agricultural commodities. The work of the OECD in the area of standardization involves both member and non-member economies and focuses on the creation of common criteria in order to facilitate international trade. Participating countries are members of the OECD, the United Nations or the World Trade Organization.

The OECD Tractor Codes provide common performance criteria overseen by the OECD Committee for Agriculture. The Committee is one of the major OECD policy committees and is responsible for implementing the agricultural programme of work. The Codes and their amendments are subject to approval by the OECD Council. They relate to the following tests:

— tractor performance (Code 2);

— strength of protective structures for standard tractors (dynamic test) (Code 3);

— strength of protective structures for standard tractors (static test) (Code 4);

— noise measurement at the driver's position(s) (Code 5);

— strength of front-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors (Code 6);

— strength of rear-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors (Code 7);

— strength of protective structures on track-laying tractors (Code 8);

— strength of protective structures on telehandlers (Code 9).

The OECD Tractor Codes are made available to those countries which are OECD Members, as well as to other countries. To date, 29 countries adhere to the Codes, including three non-OECD Members, China, India and the Russian Federation. Each National Authority designated for implementing the Codes may perform tractor tests according to the common harmonized testing procedures and then submit results to OECD for approval.

Cooperative agreements are established between OECD and certain institutions, such as ISO and the European Community, with the objective of avoiding contradictory requirements. The European Commission participates in the work of the OECD and is represented on the OECD Council (without the right of veto).

A Memorandum of Understanding (MoU) has been signed by ISO and OECD in connection with the TC 23/SC 2 programme of work on tractors.

The OECD test codes are published in French (F) and English (E), and are subject to periodic revision for dealing with the technical progress of agricultural and forestry tractors.

Agricultural tractors — Test procedures —

Part 10:
Hydraulic power at tractor/implement interface

1 Scope

ISO/OECD 789-10 specifies tests for determining the hydraulic pressure at the external hydraulic service of an agricultural tractor/implement as specified in ISO 10448, as well as companion tests for measuring the maximum hydraulic power available.

2 Normative references

The following referenced documents are indispensable for the application 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 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 6149-1:2006, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 1: Ports with truncated housing for O-ring seal*

ISO 6149-2:2006, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 2: Dimensions, design, test methods and requirements for heavy-duty (S series) stud ends*

ISO 6149-3:2006, *Connections for hydraulic fluid power and general use — Ports and stud ends with ISO 261 metric threads and O-ring sealing — Part 3: Dimensions, design, test methods and requirements for light-duty (L series) stud ends*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
agricultural tractor
self-propelled machine, either wheeled and 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 It may be provided with a detachable loading platform.

3.2
maximum engine speed
engine speed at which the throttle control is at the maximum setting

3.3
rated engine speed
engine speed specified by the tractor manufacturer for continuous operation at full load

3.4
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]

3.5
coupler pair
pair of female hydraulic couplers compatible with male couplers as 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]

3.6
available differential pressure
steady state difference of the hydraulic pressure between two male coupler parts on the implement side

[ISO 10448:1994]

3.7
maximum pressure
maximum steady state hydraulic pressure at either male coupler connected to a coupler pair

[ISO 10448:1994]

3.8
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]

3.9
maximum sump return pressure with coupler
maximum steady state hydraulic pressure at the male coupler returning flow directly to the reservoir

[ISO 10448:1994]

3.10
maximum sump return pressure 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]

3.11
rated maximum hydraulic pressure
maximum pressure as specified by the tractor manufacturer for continuous use

3.12
maximum hydraulic power
hydraulic power calculation based on the measured flow and available coupler outlet pressure (the pressure near the coupler where oil is exiting from the tractor)

NOTE The calculation does not take into account return pressure losses.

3.13
maximum useable (continuous) hydraulic power
hydraulic power calculation based on the measured flow and available differential pressure (the pressure near the coupler where oil is exiting from the tractor minus the pressure near the coupler where oil is re-entering the tractor)

NOTE The calculation takes into account the return pressure losses and defines the useable hydraulic power available.

3.14
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 apply to the maximum value measured:

a) rotational frequency, in revolutions per minute (r/min): ± 0,5 %;

b) time, in seconds (s): ± 0,2 s;

c) temperature, in degrees Celsius: ± 2 °C (applicable to actual readings);

d) pressure, in megapascals (MPa): ± 2 %;

e) flow, in litres per minute (l/min): ± 2 %.

5 General requirements

5.1 Specification

The tractor tested shall have its identification 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 For the Type 1 tests listed in Annex A (OECD Code 2 compulsory tests), the throttle or governor control lever shall be adjusted to the maximum engine speed. The engine speed is continuously recorded during the tests.

5.2.4 For the Type 2 tests listed in Annex A (OECD Code 2 supplementary tests), the engine speed condition may be either rated or maximum engine speed and is at the discretion of the manufacturer. For tests

conducted at rated engine speed, the throttle or governor control lever shall be adjusted to maintain the rated engine speed within the tolerance limits as specified in Clause 4 a). For tests conducted at the maximum engine speed, the engine speed is continuously recorded during the tests.

5.2.5 At the start of each test, the temperature of the hydraulic fluid in the tractor hydraulic reservoir shall be at 65 °C ± 5 °C, and shall be recorded. If this cannot be achieved owing to the presence of an oil cooler or other system component, the temperature measured during the test shall be stated in the test report.

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

6 Available hydraulic pressure test

6.1 Steady state

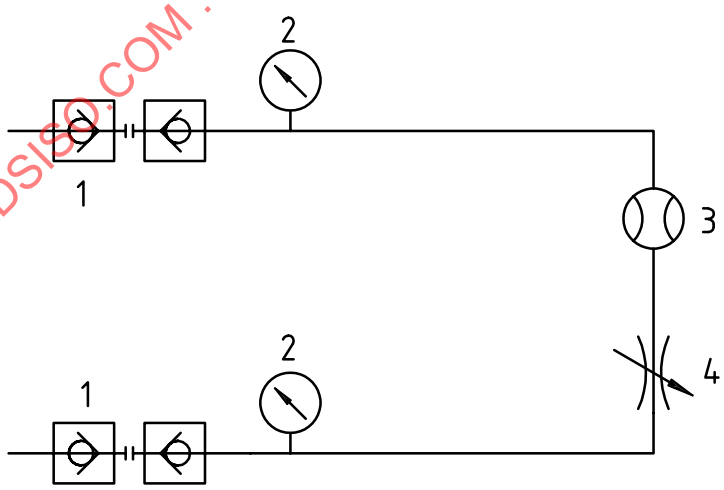
6.1.1 Test conditions

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 (see Figure 1) 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 used to vary the hydraulic load. When only Type 1 tests are conducted (see Annex A), the pressure gauge at the return coupler side is not required. Coupler size may vary with tractor flow class.

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 end shall be connected 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.



Key

1 tractor coupler pair
2 pressure gauge
3 flow meter
4 adjustable restrictor valve

Figure 1 — Steady state test assembly

6.1.2 Test procedures

6.1.2.1 Flow through single coupler pair — Type 1 tests

Actuate the tractor external hydraulic service to route oil through the test assembly. Record the pressure near the coupler where oil is exiting from the tractor, oil flow, engine speed, and reservoir oil temperature.

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 through single coupler pair — Type 2 tests

Actuate the tractor external hydraulic service to route oil through the test assembly. Record the pressure near the coupler where oil is exiting from the tractor, the pressure near the coupler where oil is re-entering the tractor, oil flow, engine speed and reservoir oil temperature. Maximum loop return pressure is in this case the pressure near the coupler where oil is entering the tractor.

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 re-entering the tractor, oil flow, engine speed and reservoir oil temperature. Calculate the available differential pressure by subtracting the pressure of oil re-entering the tractor from the pressure of oil exiting the tractor.

6.1.2.3 Flow into sump return port with coupler — Type 2 test

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 re-entering the tractor, oil flow, engine speed and reservoir oil temperature.

6.1.2.4 Flow into sump return port without coupler — Type 2 test

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 re-entering the tractor, oil flow, engine speed and reservoir oil temperature.

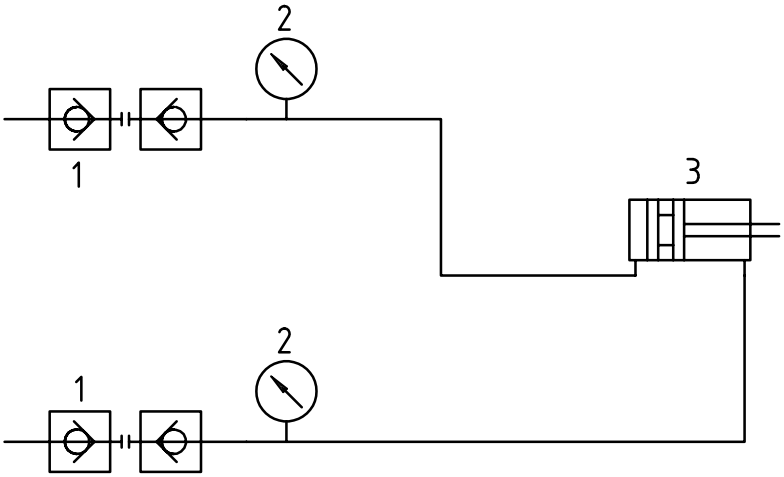
6.2 Peak pressure

6.2.1 Test conditions

The peak pressure shall be determined using a test assembly looped between a coupler pair(see Figure 2). The test assembly shall consist of a double-acting cylinder without cushion, and a pair of 2 500 mm ± 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 ± 5 mm bore, 30 mm ± 5 mm rod and 200 mm ± 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.

6.2.2 Test procedure — Maximum flow selected — Type 2 test

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”.



Key

1 tractor coupler pair
2 pressure gauge
3 cylinder

Figure 2 — Peak pressure test assembly

6.3 Test report — Available hydraulic pressure

6.3.1 Type 1 tests

A suitable test report form is presented in Annex A. The test report shall include the following information:

a) the maximum pressure;

b) the available pressure using a single coupler pair and at maximum flow condition;

c) the engine speed;

d) the minimum and maximum observed temperatures, representing the range of oil temperatures.

6.3.2 Type 2 tests

A suitable test report form is presented in Annex A. The test report may include the following information:

a) the peak pressure;

b) 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;

c) the maximum loop return pressure;

d) the maximum sump return pressure with or without coupler;

e) the engine speed;

f) the minimum and maximum observed temperatures, representing the range of oil temperatures.

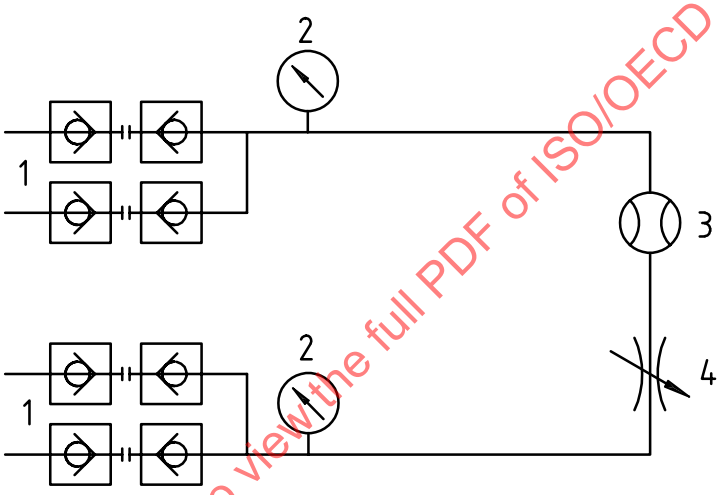
7 Available hydraulic power

7.1 Test conditions

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

a) The test assembly (see Figure 3) shall be looped between a coupler pair or pairs. The assembly shall consist of a nominal 12 mm minimum 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. 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.

b) If hydraulic power from multiple coupler pairs is to be measured (flow through two coupler pairs, or more than two if required to measure maximum available hydraulic power), additional sets of male couplers shall be provided in parallel and operated simultaneously.



Key

1 tractor coupler pair
2 pressure gauge
3 flow meter
4 adjustable restrictor valve

NOTE 1 Connection is made to the first coupler pair only when testing hydraulic power available from one coupler pair.

NOTE 2 Connection is made to both coupler pairs (or more coupler pairs, if required) when testing hydraulic power available from hydraulic power from multiple coupler pairs.

Figure 3 — Maximum hydraulic power test assembly

7.2 Test procedures

7.2.1 Hydraulic power through single coupler pair — Types 1 and 2 tests

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 the 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.

Actuate the external hydraulic service to route oil through the test assembly. Adjust the adjustable restrictor valve or engine speed to obtain a pressure equivalent to 90 % of the actual relief valve pressure setting in the circuit. Record flow and engine speed.

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

$$P = (p_1 \times q)/60$$

where

p_1 is the pressure, in megapascals (MPa), near the coupler where oil is exiting the tractor;

q is the measured flow, in litres per minute (l/min).

The maximum useable (continuous) hydraulic power, P, in kilowatts, from a single coupler pair is calculated by the following formula:

$$P = (p_1 - p_2) \times q/60$$

where

p_1 is the pressure, in megapascals (MPa), near the coupler where oil is exiting the tractor;

p_2 is the pressure, in megapascals (MPa), near the coupler where oil is re-entering the tractor;

q is the measured flow, in litres per minute (l/min).

7.2.2 Maximum available hydraulic power using two or more coupler pairs simultaneously — Types 1 and 2 tests

With the test assembly connected to two coupler pairs, or more than two coupler pairs if required, actuate all tractor external hydraulic services to route oil through the test assembly. Complete the remainder of the test according to 7.2.1.

7.3 Test report — Available hydraulic power

7.3.1 Maximum available hydraulic power — Type 1 tests

A suitable test report form is presented in Annex A. The test report shall include the following information:

a) the flow rate and the pressure at the outlet coupler when the hydraulic pressure is equivalent to 90 % of the actual relief valve pressure setting in the circuit and engine speed;

b) the hydraulic power available at the auxiliary service coupling, at the flow rate corresponding to a hydraulic pressure equivalent to 90 % of the actual relief valve pressure setting in the circuit, and where the hydraulic power is based on the corresponding outlet coupler pressure and the flow rate;

c) the flow rate with the adjustable restrictor valve fully open for one coupler pair, and for coupler pairs operating simultaneously (flow through two coupler pairs, or more than two if required);

d) the maximum hydraulic power available, based on the corresponding flow and available coupler outlet pressure for one coupler pair, and for coupler pairs operating simultaneously (flow through two coupler pairs, or more than two if required).

7.3.2 Maximum useable (continuous) available hydraulic power — Type 2 tests

A suitable test report form is presented in Annex A. The test report may include the following information:

a) the flow rate with the adjustable restrictor valve fully open for one coupler pair, and for coupler pairs operating simultaneously (flow through two coupler pairs, or more than two if required);

b) the maximum useable (continuous) hydraulic power available, and the corresponding flow and available differential pressure (pressure near coupler where oil is exiting from tractor minus the pressure near coupler where oil is re-entering the tractor) for one coupler pair, and for coupler pairs operating simultaneously (flow through two coupler pairs, or more than two if required), and corresponding engine speed.

Annex A
(normative)

Specimen test report

A.1 Tractor

Manufacturer's name and address:

Tractor model: Serial no.

Rated engine speed: rev/min

Rated maximum hydraulic pressure: MPa

A.2 Hydraulic fluid used in tests

Type: Viscosity at 65 °C: mm^2/s

Viscosity index (ISO 3448):

A.3 Type 1 tests — Available hydraulic pressure tests at maximum engine speed (OECD Code 2 hydraulic power compulsory tests)

	Pressure [a]	Reservoir oil Temperature °C (65 °C target)		Engine speed	Flow rate	Power
	MPa	min.	max.	rev/min	l/min	kW
Rated engine speed *(Manufacturer's specification)*						
ISO/OECD 789-10:2006, 6.1.2.1 Maximum (sustained) pressure with relief valve open as measured at the coupler Pump stalled: Yes/No	[b]			Engine speed (Record)		
ISO/OECD 789-10:2006, 7.2.1 Flow rate corresponding to a hydraulic pressure equivalent to 90 % of the actual relief valve pressure setting and corresponding hydraulic power	[b]	[c]		Engine speed (Record)		

	Pressure [a]	Reservoir oil Temperature °C (65 °C target)		Engine speed	Flow rate	Power
	MPa	min.	max.	rev/min	l/min	kW
ISO/OECD 789-10:2006, 6.1.2.1 Maximum available flow from one coupler pair: [d]		c		Engine speed (Record)		
ISO/OECD 789-10:2006, 6.1.2.1 Maximum available power from one coupler pair: [d]	b	c		Engine speed (Record)		
ISO/OECD 789-10:2006, 7.2.2 (OECD Code 2:2005, 4.2.2) Maximum available flow from coupler pairs operating simultaneously (flow through two or more coupler pairs if required): [d] Record number of coupler pairs tested 2 / 3 / 4 / 5		c		Engine speed (Record)		
ISO/OECD 789-10:2006, 7.2.2 (OECD Code 2:2005, 4.2.2) Maximum available flow and maximum power from coupler pairs operating simultaneously (flow through two or more coupler pairs if required): [d] Record the number of coupler pairs tested 2 / 3 / 4 / 5	b	c		Engine speed (Record)		

[a] See Clause 6 for the specific location of the pressure measurements and other referenced terms.

[b] Record pressure as measured at the outlet coupler (pressure near coupler where oil is exiting from tractor).

[c] Average test temperature.

[d] Calculated maximum power is based on only the coupler outlet pressure (pressure near coupler where oil is exiting from tractor) and does not take into account the return coupler pressure.