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R 789

TEST CODE FOR AGRICULTURAL TRACTORS
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BRIEF HISTORY

The ISO Recommendation R 789, *Test Code for agricultural tractors*, was drawn up by Technical Committee ISO/TC 22, *Automobiles (Section ISO/TC 22(T) – Agricultural Tractors)*, the Secretariat of which is held by the Association Française de Normalisation (AFNOR).

Work on this question by the Technical Committee began in 1964 and led, in 1965, to the adoption of a Draft ISO Recommendation.

In January 1966, this Draft ISO Recommendation (No. 942) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Italy	Spain
Belgium	Japan	Sweden
Brazil	Korea, Rep. of	Switzerland
Canada	Netherlands	U.A.R.
Chile	Poland	United Kingdom
Czechoslovakia	Portugal	U.S.A.
France	Romania	U.S.S.R.
Hungary	South Africa	Yugoslavia
Israel	Rep. of	

One Member Body opposed the approval of the Draft :

Germany

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in July 1968, to accept it as an ISO RECOMMENDATION.

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TEST CODE FOR AGRICULTURAL TRACTORS

1. SCOPE

This ISO Recommendation deals with the testing of agricultural tractors.

The tests measure certain performance characteristics of the tractors, in order to assess the working qualities of these tractors.

A complete test should include

- (a) technical tests made at testing stations, that is tests made under conditions that, in principle, are identical regardless of the station;
- (b) tests made under farm working conditions.

Because it is not possible to standardize the conditions in which tractors are used in farming, only tests in category (a) are included in the present document.

Only these can be carried out in accordance with uniform rules intended to give results which can be compared in all countries, and even then some differences may arise between tests in various countries due to differences in fuel quality, atmospheric conditions and local regulations controlling minor details of construction.

2. FIELD OF APPLICATION

This ISO Recommendation applies exclusively to mass-produced tractors.

Any prototype tractor tested should be subject to special agreement between the manufacturer and the testing station with regard to adjustments and the corresponding tests to be made.

3. CODE

It is necessary to list and define the operations involved in the preparation of the tractor for the tests and the requirements for the preparation of the specification sheet, and then to consider the tests themselves.

3.1 Preparation of the tractor for the tests and preparation of the specification sheet

The operations involved in the preparation of the tractor relate to the requirements concerning sampling the tractor to be tested, running-in the tractor before tests commence, making preliminary adjustments and ballasting the tractor.

The instructions for the preparation of the technical specification sheet are then given.

- 3.1.1 *Sampling.* The tractor submitted for the test is taken from series production by the manufacturer with the agreement of the testing station.

The tractor should be a production model in all respects, strictly conforming to the specification sheet submitted by the manufacturer; this sheet should accurately define the model tested.

The test report should state how the tractor was selected.

- 3.1.2 *General condition of the tractor before testing commences and preliminary adjustments.* The tractor should be new and run-in by the manufacturer before test, under his responsibility and in accordance with his usual instructions, and in collaboration with the testing station.

The test report should state the place and duration of running-in.

The adjustment of the carburettor or the injection pump and the setting of the governor should conform to the tolerances for agricultural use specified by the manufacturer.

For spark ignition engines fitted with a means for the operator to vary the ratio of the fuel/air mixture, all tests should be made and reported with the settings recommended for normal operation.

The manufacturer may make carburettor, governor, ignition and injection adjustments during the period prior to testing. These adjustments should not be changed during the tests.

- 3.1.3 *Ballasted tractor.* Wheel or track equipment and ballast weights which are commercially available and approved by the manufacturer for use in agriculture may be fitted. For tractors having pneumatic tyres, ballast in the tyres may also be used; the overall static weight on each tyre, including ballast in the tyres and the inflation pressure, should be within the limits specified by the tyre manufacturer (inflation pressure should be measured with the tyre valve in the lowest position; when this is not practicable (liquid ballast), the measured value of the pressure should be turned into the value corresponding to the lowest position of the valve). <https://standards.iteh.ai/catalog/standards/sist/157b0431-bc0c-488d-83ed-a1bb046f301a/iso-r-789-1968>

- 3.1.4 *Specification sheet.* The tractor manufacturer should supply a specification sheet of the tractor consisting of the items listed in the specimen report in Annex C, as well as any further data required to carry out the tests. These specifications should be verified by the testing station, particularly those connected with an ISO Recommendation which is of importance to the tractor user.

3.2 The tests

The purpose of the tests is to determine the operational characteristics of the tractor in different conditions. The following requirements should be taken into account.

3.2.1 General requirements

3.2.1.1 REPAIRS AND ADJUSTMENTS DURING TESTS

All repairs or adjustments made during the tests should be noted, together with comments on any practical defects or shortcomings about which there is no doubt.

3.2.1.2 FUELS AND LUBRICANTS

Fuels and lubricants should be selected from the range of products commercially available in the country where the equipment is tested but should conform to the minimum specifications approved by the tractor manufacturer.

They should be identified in the following manner :

- (a) *fuels* : legal name, type and grade, density at 15 °C or at 20 °C, octane or cetane numbers. (The temperature chosen should be stated in the report).
- (b) *lubricants* : types, viscosity. If different lubricants are used, precise information should be given as to where they are used (engine, hydraulic transmission, etc.).

If the fuel or lubricant conforms to a national or international standard, this should be mentioned and the standard stated.

3.2.2 Types of tests listed

3.2.2.1 COMPULSORY TESTS

The tests listed below are compulsory from the point of view of this ISO Recommendation.

- (1) Main power take-off tests (see clause 3.2.3).
- (2) Engine tests (see clause 3.2.4.1) which should be made compulsory only in the following circumstances :
 - (a) when the tractor is not commercially available with a power take-off,
 - (b) when the power take-off is not capable of transmitting the full power of the engine (see clause 3.2.3.6),
 - (c) when the power take-off is not mechanically connected to the engine.
- (3) Drawbar tests (see clause 3.2.6).
- (4) Determination of turning space (see clause 3.2.7.1).
- (5) Determination of turning circle (see clause 3.2.7.2).
- (6) Determination of position of centre of gravity (see clause 3.2.7.3).

For all these tests, accessories such as the hydraulic lift pump or air compressor may be disconnected only if it is practicable for the operator to do so as normal practice in work.

3.2.2.2 OPTIONAL ADDITIONAL TESTS

- (1) Engine tests (see clause 3.2.4.2).
- (2) Belt or pulley shaft tests (see clause 3.2.5).
- (3) Determination of special characteristics (see clause 3.2.7.4).

3.2.3 Tests at the main power take-off

3.2.3.1 GENERAL REQUIREMENTS

The torque and power values in the test report should be obtained from the dynamometer without correction for losses in power transmission.

In all tests, the shaft connecting the power take-off to the dynamometer should not have any appreciable angularity at the universal joints.

If, in the laboratory, use is made of an exhaust gas discharge device, it should not change the engine performance.

No correction should be made to the test results for atmospheric conditions or other factors. During maximum power tests, the ambient temperature should be between 15 and 27 °C and atmospheric pressure should not be less than 725 mm of mercury. If this is not possible because of conditions of altitude, the real pressure should be noted at the top of the test report.

In all tests, the fuel temperature should be as close as possible to that observed in the fuel feed system of the tractor under similar load conditions in normal work.

The specific consumption figures in the test report should be given as weights of fuel per unit of work.

To obtain hourly consumption by volume and the work performed per unit volume of fuel, a conversion of units of weight to units of volume should be made using the density value at 15 °C.

When consumption is measured by volume, the specific consumption should be calculated using the density corresponding to the appropriate fuel temperature.

The various tests should be carried out continuously, the governor control lever being placed in the position recommended by the tractor manufacturer for obtaining continuous maximum power.

Stable operating conditions should be attained at each load setting before beginning test measurements.

The test report should include presentation of the following curves made for the full range of engine speeds available :

- (1) power as a function of speed;
- (2) equivalent crankshaft torque as a function of speed;
- (3) hourly and specific fuel consumption as a function of speed;
- (4) specific fuel consumption as a function of power.

In addition to the performance measurements required above, the following should also be noted :

- (1) the temperature of the fuel measured at a suitable point between the tank and the engine, and the oil temperature measured at a suitable point in the oil flow;
- (2) the coolant temperature measured at the outlet of the cylinder block or cylinder head before the thermostat and, in the case of air-cooled engines, the engine temperature at a point specified by the manufacturer;
- (3) the air temperature measured at two points :
 - (a) for tractors fitted with a suction device, one approximately 2 m in front of the tractor and approximately 1.5 m above the ground and the other at the engine air intake;
 - (b) for tractors fitted with a blowing device, one approximately 2 m behind the tractor and approximately 1.5 m above the ground and the other at the engine air intake;
- (4) atmospheric pressure;
- (5) relative air humidity.

3.2.3.2 TESTS AT MAXIMUM POWER

The tractor should operate for a period of two hours subsequent to a sufficiently long warming-up period for power to become stabilized.

The maximum power quoted in the report should be the average of the readings made during the two-hour period; if the power variation exceeds $\pm 2\%$ from the average, the test should be repeated. If the variation continues to exceed $\pm 2\%$, it should be mentioned in the report.

At least six readings should be made during the two-hour test period.

3.2.3.3 TESTS AT VARYING SPEEDS AT FULL LOAD

The hourly fuel consumption, torque and power should be measured as a function of speed and the results should be set out as in the table in Annex C. To plot the curves listed in clause 3.2.3.1 the tests should go down to an engine speed at least 15% below the speed at maximum torque.

3.2.3.4 TESTS AT VARYING LOAD

In the zone controlled by the governor, the torque, speed and hourly fuel consumption should be noted as a function of power. In addition, the no-load engine speed should be recorded.

The data required to complete the section entitled "varying load" in the specimen table in Annex C should be recorded at the following loads :

- I — 85% of the torque obtained at maximum power;
- II — unloaded;
- III — half the load defined in I;
- IV — a load corresponding to maximum power;
- V — one quarter of the load defined in I;
- VI — three quarters of the load defined in I.

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3.2.3.5 STANDARD SPEED OF THE POWER TAKE-OFF

If the engine speed recommended by the manufacturer for the tests specified in clause 3.2.3.2 does not correspond to a power take-off speed conforming to ISO Recommendation R 500, *Power take-off and drawbar for agricultural tractors* (540 rev/min), and to ISO Recommendation R ...* (1000 rev/min), then the performance at the ISO recommended power take-off speed should be one of the points observed during the full load test (see clause 3.2.3.3).

The power and the hourly and specific fuel consumption at this engine speed should be measured.

The power take-off performance at the engine speed which corresponds to standard belt speed should be determined in the same manner.

3.2.3.6 SPECIAL CASES

The tests specified in clause 3.2.3 are made when the total available power can be transmitted by the main power outlets.

If this is not the case, the power take-off test should consist of a two-hour test at the rating specified by the manufacturer with a 20% overload applied every five minutes for a period not exceeding one minute.

If the engine does not withstand the 20% overload, the test should be carried out at full engine power.

* At present at the stage of draft proposal.

3.2.4 Engine tests

3.2.4.1 COMPULSORY SUBSTITUTE TESTS (made instead of power take-off tests)

The engine should be equipped with all the accessories required for continuous operation of the tractor; these should be installed in the same relative position as when fitted in the tractor.

All the provisions in clause 3.2.3 should apply to compulsory tests of the engine with the exception of those in clauses 3.2.3.5 and 3.2.3.6. A test should be carried out at the engine speed corresponding to the standard speed of the power take-off in accordance with ISO Recommendations R 500 and R ...*, unless the tractor has no power take-off.

3.2.4.2 OPTIONAL ADDITIONAL ENGINE TESTS

These tests can be carried out to supplement the main tests. In each case, any accessory which is not necessary for the continuous operation of the engine, such as the hydraulic lift pump or air compressor, should be disconnected.

When an optional additional engine test is undertaken, the provisions in clause 3.2.3 should be modified, so that measurements are also made under part-load conditions at reduced engine speed.

Sufficient data should be obtained to relate specific fuel consumption to power, torque and engine speed throughout the working range of the engine. The results should be presented graphically on one chart showing torque (ordinate) and speed (abscissa) curves of equal specific fuel consumption and equal power. The values of speed and torque should be shown respectively as percentage values of the maximum torque and of the nominal speed of the engine.

The provisions given in clause 3.2.3.5 should apply.

3.2.5 Belt or pulley shaft tests

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3.2.5.1 GENERAL CONDITIONS

The tractor pulley should be coupled to that of the dynamometer by a belt. This belt should be flexible and have appropriate power and torque transmission characteristics. Belt slip should not exceed 2% and the necessary tension to obtain this condition should be as small as possible.

The tests at the pulley shaft should be conducted by directly coupling the tractor pulley to the dynamometer shaft.

All of the provisions in clause 3.2.3, with the exception of those in clauses 3.2.3.5 and 3.2.3.6, should apply equally to the belt tests and to the pulley shaft tests.

3.2.5.2 STANDARD BELT SPEED

If the engine speed recommended by the manufacturer for tests carried out in conformity with clause 3.2.3.2 does not correspond to the standard belt speed in the country where the tests are being made, the operational characteristics of the engine at a speed corresponding to the standardized belt speed should be measured during the full load test.

The test report should indicate the power, hourly fuel consumption and specific fuel consumption in relation to engine speed.

* 1000 rev/min power take-off, at present at the stage of draft proposal.

3.2.6 Tests at the drawbar

3.2.6.1 TEST TRACKS

The tests at the drawbar should be conducted according to the following requirements, in order to provide comparable results in all countries :

- (a) for tractors with pneumatic tyres, the tests should be carried out on a clean, horizontal and dry concrete or tarmacadam surface containing a minimum number of joints;
- (b) tests of steel-wheeled tractors and track-laying tractors should be carried out on flat, dry, horizontal, mown or grazed grassland, or on a horizontal track having equally good adhesion characteristics.

A moving track (treadmill) may also be used subject to the condition that results produced are comparable with those obtained on the surfaces mentioned above. The type of test track should be clearly stated in the test report.

3.2.6.2 TESTS ON OTHER SURFACES

Additional optional tests may be carried out on other surfaces. It is recommended that the following conditions be taken into account :

- (a) firm soil conditions that produce good adhesion (which could be the track used in clause 3.2.6.1) : as a guide to suitable working conditions, it is suggested that the ground should have a minimum shear strength of 0.5 kgf/cm², measured *in situ* by a method to be detailed in the test report, at a depth of 5 to 7.3 cm and at a moisture content between 15 and 25 % (dry basis);
- (b) loose, cultivated soil conditions : for example, a soil ploughed to a depth of 20 cm and cultivated after a few days to a depth of 8 to 12 cm. It is also recommended that the moisture content be between 12 and 15 % (dry basis) and that the shear strength, measured *in situ* by a method to be detailed in the test report, should be between 0.20 and 0.35 kgf/cm².

3.2.6.3 GENERAL BASIC REQUIREMENTS CONCERNING TEST TRACKS

During all the tests at the drawbar, the governor control lever should be placed in the position recommended by the manufacturer for work at the drawbar. The line of draught should be horizontal and the height of the drawbar should remain fixed in relation to the tractor during all tests.

The manufacturer should comply with the following instructions :

- (a) the height of the drawbar should not be such that the direction of the tractor cannot be controlled when it develops maximum sustained pull;
- (b) if W is the static weight exerted by the front wheels on the ground, Z is the wheelbase, P is the maximum drawbar pull, and H is the height above ground of the line of draught, then PH should never exceed $WZ \times 0.8$;
- (c) at the beginning of the drawbar tests, the height of the tyre tread bars should not be less than 65 % of the height of the bars of the tyres when new;
- (d) measurements of the drawbar pull, speed and slip should not be started before operational conditions are stabilized.

3.2.6.4 RESULTS TO BE RECORDED

For each gear combination tested, curves showing power, forward speed, slip and specific fuel consumption should be determined as a function of the drawbar pull and included in the test report.

The coolant temperature, that of fuel and engine oil, the air temperature, the humidity and the atmospheric pressure should be measured.

In the case of the wheeled tractors, values of the performances on the test tracks as in clause 3.2.6.1 (a) should not be mentioned if the wheelslip exceeds 15 %.

With tracklaying tractors, the maximum sustained pull should be stated as a footnote beneath the table giving drawbar power values.

Measurement of fuel consumption may be omitted in tests of unballasted tractors and during tests of ballasted tractors at speeds less than 2.5 km/h.

If the tractor is equipped with a torque convertor unit fitted with a "lock-out" device which is controlled by the driver, the drawbar tests should be carried out in succession with the convertor in operation and with the convertor "locked-out".

For tractors driving four wheels, the slip of front and rear wheels should be separately measured and reported.

During all tests the forward speed should be maintained within the limits of safety of testing equipment.

3.2.6.5 TEST PROCEDURE

(a) *Tests with additional weight*

(1) *Maximum power*

Test A – Test report

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A first test series should be performed on the tractor when ballasted in accordance with the provisions of clause 3.1.3. The tests should cover at least all combinations of speed from the lowest to the combination immediately higher than that which makes it possible to develop maximum drawbar power.

(2) *Ten-hour test*

A ten-hour test should be made as follows :

For wheeled tractors on pneumatic tyres ballasted as specified in clause 3.1.3, the test should consist of two periods.

– *Test B – Test report*

Five hours in the gear specified by the manufacturer, in agreement with the testing station (this speed should be one normally used for basic agricultural work such as ploughing). The drawbar load applied should be 75 % of the pull at maximum power in the gear being used.

Values of power, pull, forward speed, slip and fuel consumption should be included in the test report.