

# ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

## ISO RECOMMENDATION 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).

- 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.

### 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

#### 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  $0.5 \text{ kgf/cm}^2$ , 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  $0.35 \text{ kgf/cm}^2$ .

#### 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

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.

In the case of tractors fitted with a hydrokinetic torque convertor that can be "locked-out" by the driver, the five-hour test should be carried out with the torque convertor in operation, within the limitations specified by the manufacturer in his published instructions. If the limiting conditions are reached, the test should be completed with the torque convertor out of operation. The respective duration of the two parts of the test should be noted in the test report and the fuel consumption separately stated.

– *Test C – Test report*

Five hours at the drawbar pull coincident with 15 % wheelslip measured during the tests specified in clause 3.2.6.4. The gear used should be the fastest gear in which the required pull can be obtained when the engine is operating under the control of the governor.

In the event of the tractor not developing sufficient power to reach drawbar pull coinciding with 15 % wheelslip, the test should be conducted at maximum available drawbar pull, keeping at this well-defined value of the pull.

It may be necessary to add supplementary ballast to reduce tyre wear and to facilitate control of the tractor.

No measurements need be taken for inclusion in the test report other than those of pull and forward speed.

In the case of tractors fitted with a hydrokinetic torque convertor that can be "locked-out" by the driver, the five-hour test should be carried out with the torque convertor in operation, within the limitations specified by the manufacturer in his operating instructions. If the limiting conditions are reached, the test should be completed with the torque convertor out of operation.

At the end of the ten-hour test, the oil consumption should be measured and expressed in units of weight/hour.

*For tracklaying and steel-wheeled tractors* the ten-hour test is made as specified in test B.

The oil consumption should be measured as described in test A.

(b) *Tests without additional weight*

*Test D – Test report*

The lowest speed combination P allowing the maximum power to be developed and the highest speed combination Q allowing maximum pull to be developed should be considered.

The tests should be made at least from the combination closest to P which gives a speed greater than that corresponding to P up to the combination closest to Q which gives a speed less than that corresponding to Q.

### 3.2.7 *Complementary measurements*

#### 3.2.7.1 TURNING SPACE

These measurements are made on one or other of the surfaces mentioned in clause 3.2.6.1 according to the kind of tractor under test. The track-setting should be one commonly used in the country in which the test is made and should be stated. Tests should be made turning right and left, with and without use of the steering brakes.

#### 3.2.7.2 TURNING CIRCLE

Proceed as in clause 3.2.7.1, measuring the left and right diameters, with and without use of the steering brakes.

#### 3.2.7.3 POSITION OF CENTRE OF GRAVITY

To enable the effects of gradients on tractive effort and stability to be evaluated, the position of the centre of gravity of the tractor should be determined with and without ballast, with full tanks and the driver replaced by a weight of 75 kg on the driver's seat.

#### 3.2.7.4 SPECIAL CHARACTERISTICS OF THE TRACTOR

Supplementary measurements to determine special characteristics of the tractor may be made, providing all the compulsory tests have been carried out.

The results should be reported in an annex to the test report.

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## ANNEX A

### VOCABULARY

#### GENERAL REMARKS

1. The tractor should stand on a rigid horizontal surface. Dimensions of length and width are then measured on horizontal lines and those of height on vertical lines.
2. The vehicle should be stationary with its wheels and components in the positions they would be in if it were travelling in a straight line, unless otherwise stated.
3. The pressure in pneumatic tyres should be adjusted to the value recommended by the tractor manufacturer for field work.  
If additional ballast or equipment is fitted so that this pressure is too low to be in accordance with the tyre manufacturer's recommendations, then pressure should be adjusted to conform to these recommendations.
4. The definitions of the dimensions apply to new vehicles normally equipped.

#### DEFINITIONS

##### A.1 Agricultural tractors

Self-propelled vehicles with wheels, having at least two axles, or tracks, having two tracks and designed to carry out the following operations, primarily for agricultural purposes :

- pulling trailers,
- carrying, pulling or propelling agricultural tools or machinery and, where necessary, supplying power to operate them with the tractor in motion or stationary.

An agricultural tractor may be equipped with a removable charging platform, which permits it, in particular, to carry agricultural products, placed on the tractor.

##### A.2 Track

###### A.2.1 Preliminary definition : median plane of the wheel

The median plane of the wheel is equidistant from the two planes containing the periphery of the rims at their outer edges.

###### A.2.2 Definition of track

The vertical plane through the wheel axis intersects its median plane along a straight line which meets the supporting surface at one point.

If A and B are two points thus defined for the wheels on the same axle of the tractor, then the track width is the distance between points A and B. The track may be thus defined for both front and rear wheels.

Where there are twin wheels, the track is the distance between two planes, each being the median plane of one pair of wheels, at right angles to the axis of the pairs of wheels.

For tracklaying tractors, the track is the distance between the median planes of the tracks.

**A.2.3 Additional definition : median plane of the tractor**

Take the extreme positions of points A and B for the tractor rear axle, which gives the maximum possible value for the track. The vertical plane at right angles to the centre point of the segment AB is the median plane of the tractor.

**A.3 Wheelbase**

Distance between the vertical planes passing through the segment AB as defined above one for the front wheels and one for the rear wheels.

**A.4 Ground clearance**

Distance between the supporting surface and the lowest point of the tractor, the tractor being loaded to its maximum permissible weight.

**A.5 Length**

Maximum distance between the two vertical planes at right angles to the median plane of the tractor and touching its front and rear extremities.

All parts of the tractor and, in particular, all fixed components projecting at the front or rear (drawbar, etc.) are contained between these two planes.

Hitch components at front and rear removable without implements are not included in the length.

**A.6 Width**

Maximum distance between two vertical planes, parallel to the median plane of the tractor, each plane touching the outermost point of the vehicle on its respective side.

All parts of the tractor and, in particular, all fixed components projecting laterally (wheel hubs, etc.) are contained between these two planes.

**A.7 Height**

Maximum distance between the supporting surface and the horizontal plane touching the uppermost point of the vehicle.

All parts of the tractor and, in particular, all fixed components projecting upwards are contained between these two planes.

**A.8 Dry weight**

Static weight of the tractor fitted with all components necessary for its operation, but without water, fuel or oil, without a driver and without ballast.

**A.9 Operational weight**

Static weight of the tractor in working order with full tank and radiator and including the weight of the driver (assumed to be 75 kg). Any working equipment fitted should be stated.

**A.10 Maximum total weight ballasted**

Maximum permissible static weight having regard to the limitations imposed by the tractor components, including tyres, and legal requirements.

**A.11 Load on front and rear axles**

Total load transmitted to the supporting surface by the wheels on the respective axle.

**A.12 Position of centre of gravity**

The position of the centre of gravity is defined by

- height above the supporting surface,
- distance (to right or left) from the median plane of the tractor,
- distance from the vertical plane passing through the segment AB representing the track of the rear wheels.

**A.13 Turning space**

The tractor is assumed to be moving slowly (2 km/h) with the steering wheels on full lock. The turning space is the diameter of the smallest circle described by the outermost point of the vehicle. The turning space is measured separately for right and left turns.

**A.14 Turning circle**

The tractor is assumed to be moving slowly (2 km/h) with the steering wheels on full lock. The turning circle is the diameter of the circle described by the median plane of the outermost steering wheel. The turning circle is measured separately for right and left turns.

**A.15 Power outlet**

Any outlet through which the tractor engine power can be transmitted, such as power take-off, belt pulley or any other take-off shaft.

**A.16 Rated speed and recommended speed**

The rated speed of the engine is the speed in revolutions per minute specified by the tractor manufacturer for continuous operation at full load.

There may be one or more different recommended speeds for particular uses of the tractor.

**A.17 Theoretical forward speed of tractor at rated engine speed**

The theoretical forward speed should be determined from the rated engine speed having regard to

- the total gear ratio,
- the radius of the tyres under load as specified by the tyre manufacturer.

**A.18 Engine power at rated speed**

Maximum sustained power at the crankshaft with the engine running at the rated speed specified by the tractor manufacturer for continuous operation at full load.

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

**A.19 Belt power**

Sustained power measured at the dynamometer after transmission by the belt, the governor control being in the position recommended by the tractor manufacturer for pulley work.

**A.20 Pulley power**

Sustained power measured by coupling the pulley shaft directly to the dynamometer, the governor control being in the position recommended by the tractor manufacturer for pulley work.

**A.21 Power at the main power take-off**

Sustained power at the main power take-off shaft, the governor control being in the position recommended by the tractor manufacturer for power take-off work and the tractor being stationary.

**A.22 Power at the drawbar**

Sustained power available at the drawbar for a given distance, the governor control being in the position recommended by the manufacturer for drawbar work and the tractor moving on a horizontal surface, the drawbar pull being applied horizontally.

The drawbar power should be stated with reference to the gear ratio used, the weight of the tractor and how distributed, type of track, height of drawbar, tyre sizes and inflation pressure.

The pump for the hydraulic lift and the air compressor should not be disconnected unless this can actually be done in normal current use. If not, they should remain connected and operate at minimum load.

**A.23 Specific fuel consumption**

The weight of fuel consumed per unit of work.

**A.24 Maximum drawbar pull**

The mean maximum sustained pull which the tractor can maintain at the drawbar over a given distance, the pull being exerted horizontally and in the median plane of the tractor.

**A.25 Slip**

(a) *Belt slip*; this is determined by the following formula :

$$\text{pulley slip} = \frac{100 (n_0 - n_1)}{n_0} (\%)$$

where

- $n_0$  is the number of revolutions per minute of the driven pulley without slip,
- $n_1$  is the number of revolutions per minute of the driven pulley under load.

(b) *Slip of the driving wheels or tracks*; this is determined by one of the following formulae :

$$\frac{100 (I_0 - I_1)}{I_0} (\%)$$

or

$$\frac{100 (n_1 - n_0)}{n_1} (\%)$$

where

- $I_0$  is the distance travelled by the driving wheels or tracks without slip for a specified number of revolutions,
- $I_1$  is the distance travelled by the driving wheels or tracks for the same number of revolutions but with slip,
- $n_1$  is the number of revolutions of the driving wheels or sprockets for a given distance with slip,
- $n_0$  is the number of revolutions of the driving wheels or sprockets for the same distance without slip.

ANNEX B

PERMISSIBLE MEASUREMENT TOLERANCES

Rotational speed	$\pm 0.5\%$
Weight	$\pm 0.5\%$
Intervals of time	$\pm 0.2\text{ s}$
Fuel consumption	
– drawbar tests	$\pm 2\%$
– p.t.o. and engine tests	$\pm 1\%$
Drawbar pull	$\pm 1\%$
Travel speed	$\pm 1\%$
Temperature of engine oil	$\pm 2\text{ }^{\circ}\text{C}$
Temperature of coolant	$\pm 2\text{ }^{\circ}\text{C}$
Temperature of fuel	$\pm 2\text{ }^{\circ}\text{C}$
Atmospheric temperature	$\pm 0.5\text{ }^{\circ}\text{C}$
Atmospheric pressure	$\pm 1\text{ mmHg}$

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ANNEX C

TEST REPORT MODEL

Tractor submitted for test by . . . . . (Manufacturer's name and address)

PART 1 (C.1)

SPECIFICATION OF TRACTOR

Where alternative data are required, for example, in the case of ignition equipment for different types of engine, all relevant headings should be given; in an actual report only those headings which are relevant need be used.

**Tractor**

Make . . . . . Model . . . . .  
Type . . . . . Serial No. . . . .

**Engine**

Make . . . . . Model . . . . .  
Type . . . . . Serial No. . . . .

**Cylinders**

Number . . . . . Arrangement . . . . . Bore/stroke . . . . . mm . . . . . in  
Capacity . . . . . cm<sup>3</sup> . . . . . in<sup>3</sup> . . . . . Compression ratio . . . . .  
Arrangement of valves . . . . . Cylinder liners . . . . .

**Fuel feed and ignition system**

Type of fuel feed . . . . .  
Type, make and model of fuel filter(s) . . . . .  
Capacity of fuel tank . . . . . l . . . . . gal  
Type, make and model of injection pump . . . . . Serial No. . . . .  
Manufacturer's production setting . . . . .  
Type, make and model of injectors . . . . . Manufacturer's production setting . . . . .  
Type, make and model of magneto coil and distributor . . . . .  
Type, make and model of carburetter . . . . . Sizes of fuel jets . . . . .  
Ignition timing . . . . . Sparking plugs (make and model) . . . . .

**Governor**

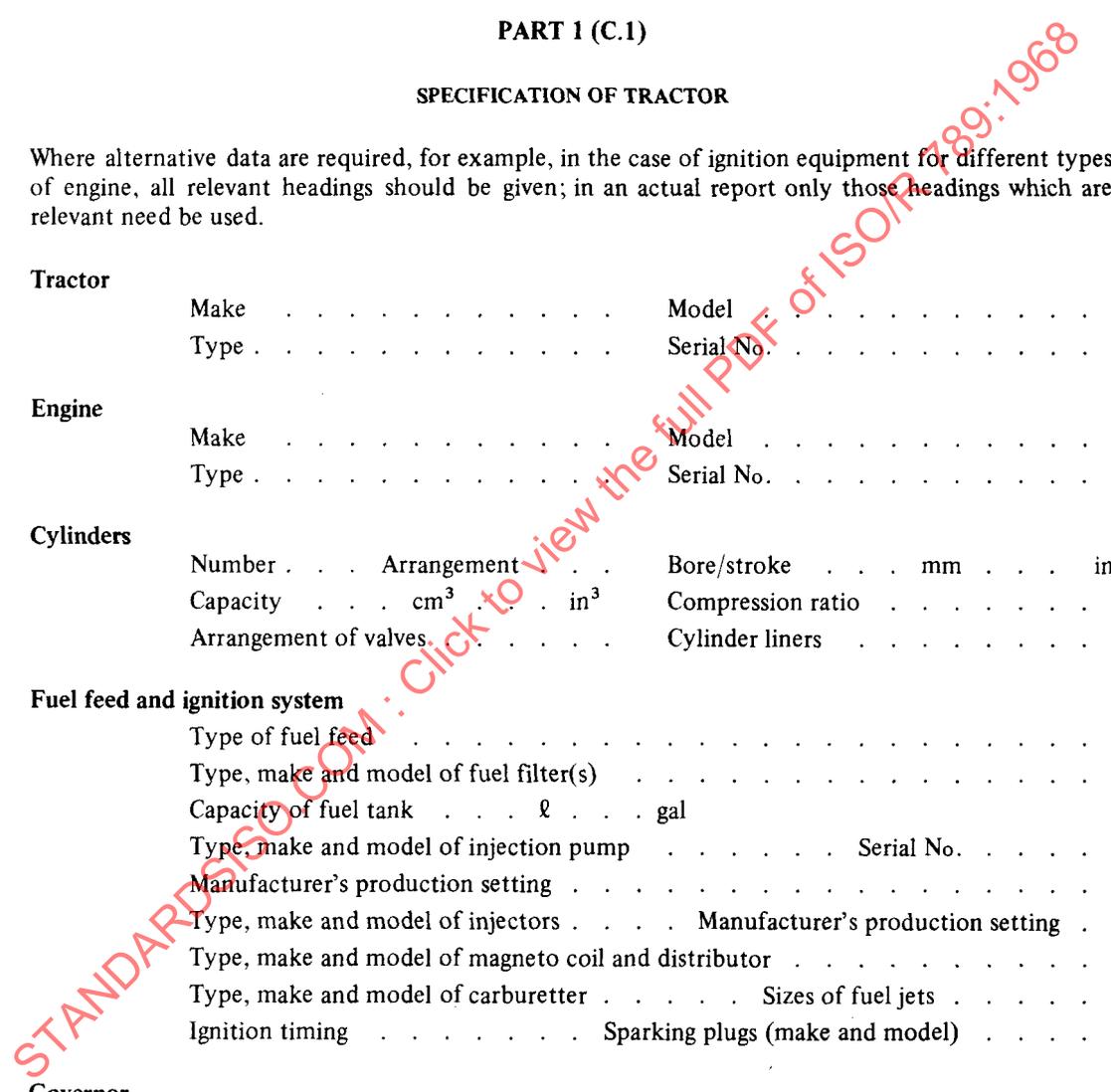
Make . . . . .  
Type . . . . . Range of speed . . . . .  
Rated speeds . . . . . rev/min

**Air cleaner**

Make . . . . . Type . . . . . Oil capacity . . . . . l . . . . . gal

**Pre-cleaner**

Make . . . . . Type . . . . .



**Lubrication system**

Type . . . . . Type and number of filters . . . . .  
Oil capacity . . . . . ℓ . . . . pt Changing period . . . . . h

**Cooling system**

Type . . . . . Details of pump and fan . . . . .  
Coolant capacity . . . . . ℓ . . . . gal Means of temperature control . . . . .  
Pressure details . . . . . kgf/cm<sup>2</sup> (or bar) \* . . . . . lbf/in<sup>2</sup>

**Starting system**

Make . . . . . Type . . . . .  
Aids for cold starting . . . . .

**Electrical system**

Voltage . . . . .  
Generator . . . . . Make . . . . . Type . . . . .  
Battery . . . . . Make . . . . . Type . . . . . Capacity and number . . . . .

**Transmission**

*Clutch*

Make . . . . . Type and size . . . . . mm . . . . . in  
Method of operation . . . . .

*Gearbox*

Make . . . . . Type . . . . .  
Number of speeds . . . . .

*Rear axle and final drive*

Make . . . . . Type . . . . .  
Differential lock . . . . . Type . . . . .

Details of transmission if other than above . . . . .

*Oil capacity*

Gearbox . . . . . ℓ . . . . pt Rear axle . . . . . ℓ . . . . pt  
Final drives . . . . . ℓ . . . . pt  
Changing period . . . . . h

Gear number	Number of engine revolutions for one revolution of driving wheel or sprocket	Nominal travelling speed for rated speed of engine	
		km/h	mile/h

\* 1 kgf/cm<sup>2</sup> = 1 bar within 2 % .  
1 bar = 10<sup>5</sup> N/m<sup>2</sup> .

**Main power take-off**

Location . . . . . Dimensions . . . . . mm . . . . . in  
 Number of splines . . . . .  
 Height above ground . . . . . mm . . . . . in  
 Proportional engine speed . . . . . rev/min at . . . . . rev/min engine speed  
 Engine speed . . . . . rev/min at standard p.t.o. . . . .  
 Speed . . . . . rev/min  
 Direction of rotation . . . . .  
 Proportional ground speed : distance travelled for one revolution of p.t.o.  
 . . . . . mm . . . . . in  
 Number of p.t.o revolutions for one revolution of driving wheel or sprocket . . . . .  
 Direction of rotation . . . . .  
 (Viewed from behind the tractor and with tractor in forward gear.)

**Belt pulley**

Location . . . . . Dimensions . . . . . mm . . . . . in (diameter and width of face)  
 Speeds : Linear . . . . . m/min . . . . . ft/min  
 At rated engine speed . . . . . rev/min  
 Engine speed . . . . . rev/min at standard linear speed . . . . . m/min . . . . . ft/min

**Power lift**

Make . . . . . Type . . . . . Oil capacity . . . . . ℓ . . . . . pt  
 Oil delivery at rated engine speed . . . . . ℓ/min . . . . . pt/min  
 at . . . . . kgf/cm<sup>2</sup> (or bar) . . . . . lbf/in<sup>2</sup>.  
 Maximum permissible load at end of lower links . . . . . kgf (or daN)\* . . . . . lbf  
 (manufacturer's figure) . . . . . kgf (or daN)\* . . . . . lbf  
 Vertical lift movement . . . . . mm . . . . . in, to . . . . . mm . . . . . in, above ground

**Drawbar**

Type . . . . .  
 Height above ground, maximum . . . . . mm . . . . . in, minimum . . . . . mm . . . . . in  
 Method of changing position . . . . .  
 Distance from rear axle . . . . . mm . . . . . in  
 Position relative to p.t.o. . . . . mm . . . . . in  
 Lateral adjustment . . . . . mm . . . . . in  
 Pivot position relative to rear wheel or sprocket centre . . . . . mm . . . . . in

**Hitch**

Height above ground . . . . . mm . . . . . in  
 Distance from rear axle . . . . . mm . . . . . in  
 Position relative to p.t.o. . . . . mm . . . . . in

\* 1 kgf = 1 daN within 2<sup>o</sup>/<sub>100</sub>.

**Steering**

Make . . . . . Type . . . . . Method of operation. . . . .

**Brakes**

Make . . . . . Type . . . . . Method of operation. . . . .

**Wheeled tractors**

*Steering wheels*

Number . . . . . Position . . . . .  
 Type of tyres . . . . .  
 Size . . . . . Ply rating . . . . .  
 Maximum permissible load on each tyre . . . . . kgf (or daN) . . . . . lbf  
 at a pressure of . . . . . kgf/cm<sup>2</sup> (or bar) . . . . . lbf/in<sup>2</sup>  
 Track widths . . . mm . . . in Method of changing . . . . .

*Driving wheels*

Number . . . . . Position . . . . .  
 Type of tyres . . . . .  
 Size . . . . . Ply rating . . . . .  
 Rim size . . . . .  
 Maximum permissible load on each tyre . . . . . kgf (or daN) . . . . . lbf  
 at a pressure of . . . . . kgf/cm<sup>2</sup> (or bar) . . . . . lbf/in<sup>2</sup>  
 Track widths . . . mm . . . in Method of changing . . . . .  
 Wheelbase . . . . . mm . . . in

NOTE. — If steel wheels are fitted to tractor, appropriate dimensions should be given.

**Tracklaying tractors**

Type of track . . . . . Number of track plates . . . . .  
 Width of track plates . . . mm . . . in Grouser height . . . mm . . . in  
 Track pitch . . . mm . . . in  
 Track gauge . . . mm . . . in  
 Length of track in ground contact . . . . . mm . . . . . in  
 Surface of track in ground contact . . . . . cm<sup>2</sup> . . . . . in<sup>2</sup>  
 Nominal ground pressure . . . . . kgf/cm<sup>2</sup> (or bar) . . . . . lbf/in<sup>2</sup>  
 Driving sprocket - pitch diameter . . . mm . . . in Number of teeth . . . . .  
 Face width . . . . . mm . . . in  
 Suspension, type . . . . .  
 Details of idler wheels . . . . .  
 Details of top and bottom rollers . . . . .  
 Method of lubrication . . . . .  
 Tractor and ballast weights  
 (without driver but with tanks full) . . . . . kgf (or daN) . . . . . lbf  
 Weight of tractor without ballast : Front . . . . . kgf (or daN) . . . . . lbf  
 Rear . . . . . kgf (or daN) . . . . . lbf  
 Total . . . . . kgf (or daN) . . . . . lbf

**Ballast weights**

<i>Front</i>	Weights . . . . . per wheel . . . . .	kgf (or daN)	. . . . .	lbf
	Frame weights . . . . .	kgf (or daN)	. . . . .	lbf
	Water . . . . .	kgf (or daN)	. . . . .	lbf
<i>Rear</i>	Weights . . . . . per wheel . . . . .	kgf (or daN)	. . . . .	lbf
	Water . . . . .	kgf (or daN)	. . . . .	lbf
	Additional weights . . . . .	kgf (or daN)	. . . . .	lbf
Total weight, tractor with maximum ballast				
	Front . . . . .	kgf (or daN)	. . . . .	lbf
	Rear . . . . .	kgf (or daN)	. . . . .	lbf
	Total . . . . .	kgf (or daN)	. . . . .	lbf

**Overall dimensions**

Overall length . . . . .	m	. . . . .	ft	. . . . .	in
Overall width with and without ballast weights . . . . .	m	. . . . .	ft	. . . . .	in
Overall height . . . . .	m	. . . . .	ft	. . . . .	in
Minimum ground clearance and position . . . . .	m	. . . . .	ft	. . . . .	in

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