SAE International™

# SURFACE VEHICLE STANDARD

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## Agricultural Tractor Test Code (OECD)

## Equivalent to Organisation for Economic Co-operation and Development D(87)53



**1.** ***Scope—***The purpose of this SAE Standard is to define test conditions, describe tests to be made, specify data to be obtained, show formulas and calculations, define terms, and establish a uniform method of reporting so that performance data obtained on various makes and models of tractors, tested in accordance with this document, will be comparable regardless of where the tests are made. Because of the availability of many tractor models and types that can be equipped with a variety of special or optional equipment, the scope of this document must be limited to obtaining and reporting only the most significant of widely used performance data.

Tests performed to either the Standard Code as outlined in Section 5 or the Restricted Code as outlined in Section 6 will satisfy requirements of this Agricultural Tractor Test Code.

This document is technically equivalent to the OECD Tractor Test Code C(87)53, Annex I and Annex II. It is intended as a guide to development and pretesting of tractors prior to official OECD testing. It is not, however, a replacement for the official codes used by OECD test stations, and any questions or conflicts concerning official OECD testing should be resolved by consulting the official OECD codes of the OECD Coordinating Center in Paris.

OUTLINE OF TEST CODE





**TO PLACE A DOCUMENT ORDER:**
**Tel: 877-606-7323 (inside USA and Canada)**
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**SAE WEB ADDRESS: http://www.sae.org**

## 2. References

**2.1 Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE TSB 003—Rules for SAE Use of SI (Metric) Units

2.1.2 IEC PUBLICATION—Available from IEC, 3, rue de Verambe, P.O. Box 131, 121 Geneva 20, Switzerland.

IEC No. 651

2.1.3 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO730/1-1977—Agricultural wheeled tractors—Rear-mounted three-point linkage Part 1: Categories 1, 2 and 3
ISO730/2-1979—Agricultural wheeled tractors—Three-point linkage—Part 2: Category 1 N (Narrow Hitch)
ISO730/3-1982—Agricultural wheeled tractors—Three-point linkage—Part 3: Category 4
ISO3448/1975—Industrial liquid lubricants—ISO viscosity classification
ISO4251/1-1984—Tyres and rims (existing series) for agricultural tractors and machines—Part 1: Tyre designation and dimensions

## 3. Definitions

**3.1 Agricultural Tractors—**Self-propelled wheeled tractors, having at least two axles, or with tracks, designed to carry out the following operations, primarily for agricultural purposes:

a. To pull trailers
b. To carry, pull, or propel agricultural tools or machinery and, where necessary, to supply power to operate them with the tractor in motion or stationary

**3.2 Median Plane of Tractor Wheel—**The median plane of the wheel which is equidistant from the two planes containing the periphery of the rims at their outer edges.

**3.3 Median Plane of Tractor Tracks—**The median plane of the track (for track-laying tractors) which is equidistant from the two planes containing the periphery of the outer edges of the track.

**3.4 Tractor Track—**For wheeled tractors with pneumatic tires, the track is the distance between the points of intersection of a horizontal supporting surface and the median planes of the left and right wheels on a common axis. For dual wheels, the distance is measured from points midway between the median planes of the pair of wheels on each end of the axis.

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

**3.5 Median Plane of the Tractor—**The longitudinal vertical plane which bisects the rear axle tractor track with the rear wheels set to their maximum width.

**3.6 Wheelbase—**The horizontal distance between the vertical planes passing through the axes of the front wheels and the rear wheels, respectively.

**3.7 Radius of Turning Area—**The radius of the smallest circle described by the outermost point of the tractor.

**3.8 Radius of Turning Circle—**The radius of the smallest circle tangentially described by the median plane of the outermost wheel.

**3.9 Ground Clearance—**The distance between the supporting surface and the lowest point of the tractor.

**3.10 Length—**The 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 of the components projecting at the front or rear (that is, drawbar) are contained between these two planes.

Removable hitch components at front and rear are not included in the length.

**3.11 Width—**The distance between two vertical planes parallel to the median plane of the tractor, each plane touching the outermost point of the tractor on its respective side. All parts of the tractor, in particular all fixed components projecting laterally (that is, wheel hubs) are contained between these two planes.

**3.12 Height—**The distance between the supporting surface and the horizontal plane touching the uppermost part of the tractor.

**3.13 Unballasted Mass—**The mass of the tractor without driver and ballasting devices. The tractor shall be in running order with tanks, hydraulic system, and radiator full, and in the case of tractors with pneumatic tires, without liquid ballast.

**3.14 Position of Center of Gravity—**The position of the center of gravity is defined by:

a. Height above the supporting surface

b. Distance to right or left of the median plane of the tractor

c. Distance from the vertical plane passing through the line representing the track of the rear wheels, or sprockets

**3.15 Rated Speed of the Engine—**The engine speed specified by the manufacturer for continuous operation at full load.

**3.16 Engine Power—**The power measured at the flywheel or the crankshaft.

**3.17 Belt Power—**The power measured at the belt dynamometer.

**3.18 Power Takeoff Power—**The power measured at any shaft designed by the tractor manufacturer to be used as a power takeoff.

**3.19 Power at the Drawbar—**The power available at the drawbar sustainable over a distance of at least 20 m.

**3.20 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 vertical plane containing the longitudinal axis of the tractor.

**3.21 Specific Fuel Consumption—**The mass of fuel consumed per unit of work.

**3.22 Specific Energy—**Work per unit volume of fuel consumed.

### 3.23 Transmission Types

3.23.1 SELECTIVE GEAR FIXED RATIO TRANSMISSION—A transmission of such design that the ratio of engine speed to final drive member speed can be changed but with interruption of power to the final drive members.

3.23.2 TORQUE MULTIPLIER—A mechanism capable of automatically multiplying the engine torque. In this case, the increased torque produces a corresponding increase in drawbar pull.

NOTE—The torque converter falls into this classification.

3.23.3 TORQUE MULTIPLIER LOCKOUT—A means by which the torque multiplier can be made inoperative.

3.23.4 AUTOMATIC POWER SHIFTING FIXED RATIO TRANSMISSION—It is of such design that it automatically shifts from one fixed ratio to another.

3.23.5 OPERATOR CONTROLLED POWER SHIFTING FIXED RATIO TRANSMISSION

*3.23.5.1* *Full Range*—This type of transmission is of such design that the operator can change from any fixed ratio to any other fixed ratio with the tractor under power.

*3.23.5.2* *Partial Range*—This type of transmission is of such design that the operator can change from certain fixed ratios to other fixed ratios with the tractor under power.

3.23.6 INFINITELY VARIABLE TRANSMISSION—This type of transmission is of such design that the operator can infinitely vary the ratio between engine and final drive members throughout part or all of the speed range of the tractor. This type of transmission includes electrical, hydrostatic, friction, and any other devices.

### 3.24 Slip

3.24.1 BELT SLIP—Belt slip is determined by Equation 1:

$$\text{Belt slip (\%)} = 100\ (n_0 - n_1)/n_0 \qquad \text{(Eq. 1)}$$

where:

$n_0$ = Number of revolutions per minute of the driven pulley without slip
$n_1$ = Number of revolutions per minute of the driven pulley under load

3.24.2 DRIVE WHEEL OR TRACK SLIPPAGE—Slip of the driving wheels or tracks is determined by Equation 2:

$$\text{Wheel or track slip (\%)} = 100\ (N_1 - N_0)/N_1 \qquad \text{(Eq. 2)}$$

where:

$N_1$ = Sum of the revolutions of all driving wheels or tracks for a given distance with slip
$N_0$ = Sum of the revolutions of all driving wheels or tracks for the same distance without slip

In the case of tractors having four driving wheels not mechanically locked together, the revolutions of each wheel should be separately recorded and the slip calculated for each wheel. If the results differ by more than 5%, they should be noted and separately reported.

## *4. Test Conditions*

**4.1 Tractor Selection—**The tractor submitted for the test shall be taken from series production by the manufacturer with the agreement of the testing station.

The tractor shall be a production model in all respects, strictly conforming to the description and specification sheet submitted by the manufacturer, which must accurately define the model tested.

The testing of a preproduction model tractor is permitted under special circumstances. If this is done, the testing station must certify in the published report that it has checked that the series production conforms to the specification of the tested tractor.

The test report shall state how the tractor was selected.

**4.2 Manufacturer's Instructions—**Once the test has started the tractor shall never be operated in a way that is not in accordance with the manufacturer's published instructions in the operator's manual.

**4.3 Fuels and Lubricants—**Fuels and lubricants shall be selected from the range of products commercially available in the country where the equipment is tested but shall conform to at least the minimum standards approved by the tractor manufacturer. If the fuel or lubricant conforms to a national or international standard, the standard shall be stated.

**4.4 Testing Two Versions of the Same Tractor—**If, at the request of the manufacturer, two- and four-wheel drive versions of one tractor are tested together, the one version being modified to become the other, the same engine must be used in both and there must be no change in the transmission of power from the engine to the power takeoff. Power takeoff power must be checked as well as the conformity of the second version with the manufacturer's specifications. It is then not necessary to repeat the full power takeoff test. If two- and four-wheel drive versions of a single tractor are tested together and if the tractor's position relative to the ground is different in one version relative to the other, the lifting force of each must be checked. If this differs by more than 5%, the hydraulic lift in each version must be tested and a separate table for each included in the test report.

**4.5 Retesting—**A testing station will only retest a tractor model if it has been modified so that its performance may be affected. If the name only has been changed, the station may certify that the test already reported applied to the new tractor.

When a testing station submits a test report for a retest it must point out the modifications that justify the new test.

**4.6 Supplementary Tests—**Supplementary test reports to any approved test report are allowed after tractor modification only for power takeoff, braking, noise, hydraulic power, and lifting force tests.

It is the responsibility of the testing station to confirm that all features not covered by the supplementary report give performance figures within 5% of the original performance figures [1dB(A) for noise]. When the power takeoff is retested only fuel consumption may change. The power must remain within the limits stated. It is not necessary to check fuel consumption in the drawbar test.

**4.7 Running-In and Preliminary Adjustments—**The tractor shall be new and run in by the manufacturer before the test, under his responsibility and in accordance with his usual instructions and in collaboration with the testing station. If this procedure is impracticable because the tractor is an imported model, the testing station may run-in the tractor, provided that the authority of the manufacturer or his representative, who will remain responsible for the running-in, is obtained.

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

The carburetor or injection pump adjustment and the governor setting shall conform to the manufacturer's specifications.

The manufacturer may make adjustments in conformity with the specifications during the period prior to testing. These adjustments shall not be changed during the test.

**4.8 Ballasting—**Ballast weights may be fitted. For tractors having pneumatic tires, liquid ballast in the tires may also be used; the overall static weight on each tire (including liquid ballast in the tires and a 75 kg weight representing the driver), and the inflation pressure shall be within the limits specified by the tire manufacturer, except as specified for the 5-h test (5.1.3.4.2); inflation pressure shall be measured with the tire valve in the lowest position.

**4.9 Specification Sheet—**The tractor manufacturer shall supply a specification of the tractor consisting of the items listed in the specimen test report (Appendix A), as well as any further data required to carry out the tests. These technical specifications shall be checked as far as possible by the testing station.

While checking the dimensions:

The tractor must be standing on a hard horizontal surface. Dimensions of length and width are then measured horizontally and those of height vertically;

The tractor must be stationary with its wheels and components positioned for straight line travel, unless otherwise stated;

The pressure in pneumatic tires must be adjusted to give the dynamic radius index appropriate to the tire size (see ISO 4251/1-1984).

The definitions of the dimensions apply to new tractors normally equipped.

**4.10 Repairs During Tests—**All repairs made during the tests shall be noted, together with comments on any practical defects or shortcomings about which there is not doubt.

**4.11 Auxiliary Equipment—**For all tests, accessories such as 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, in accordance with the operator's manual and without using tools, except as otherwise specified for a particular test. If not, they should remain connected and operate at minimum load.

**4.12 Operating Conditions—**No corrections shall be made to the test results for atmospheric conditions or other factors. Atmospheric pressure shall not be less than 96.6 kPa. If this is not possible because of conditions of altitude, a modified fuel pump setting may have to be used, details of which will be included in the report. The pressure will be noted in the report. Stable operating conditions must have been attained at each load setting before beginning test measurements.

**4.13 Fuel Consumption—**When consumption is measured by mass, to obtain hourly consumption by volume and the work performed per unit volume of fuel, a conversion of units of mass of volume shall be made using the density value at 15 °C.

When consumption is measured by volume, the mass of fuel per unit of work shall be calculated using the density corresponding to the fuel temperature at which the measurement was made. This figure shall then be used to obtain hourly consumption by volume and the work performed per unit volume of fuel, using the density value at 15°C for conversion from units of mass to units of volume.

**4.14 Test Track—**The tests at the drawbar shall be conducted according to the following regulations in order to provide reasonably comparable results in all countries:

For tractors with pneumatic tires, the tests shall be carried out on a clean, horizontal, and dry concrete or tarmacadam surface containing a minimum number of joints;

Tests of steel-wheeled tractors and track-laying tractors shall be carried out on a 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 to those obtained on the surfaces mentioned previously;

The type of test track shall be clearly stated in the report.

**4.15 Instrumentation—**All measurements shall be obtained with instruments and test equipment having an accuracy representative of good laboratory practice.

4.15.1 PERMISSIBLE MEASUREMENT TOLERANCES

a. Rotational speed: ±0.5%
b. Time: ±0.2 s
c. Distance: ±0.5%
d. Force: ±1.0%
e. Mass: ±0.5%
f. Atmospheric pressure: ±0.2 kPa
g. Tire pressure: ±5.0%
h. Hydraulic system pressure: ±2.0%
i. Temperature of fuel, etc.: ±2.0 °C
j. Wet and dry bulb thermometers: ±0.5 °C

## *5. Test Procedures - Standard Code*

### 5.1 Required Tests

5.1.1 MAIN POWER TAKEOFF

*5.1.1.1 Test Conditions*—The torque and power values in the test report shall be obtained from the dynamometer without correction for losses in power transmission between the power takeoff and the dynamometer.

The shaft connecting the power takeoff to the dynamometer shall not have any appreciable angularity at the universal joints.

The surrounding temperature shall be 23 °C ± 7 °C. Atmospheric pressure shall fulfill the conditions defined in 4.12.

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

The various tests shall be carried out continuously.

5.1.1.2 *Maximum Power Test*—The governor control being set for maximum power, the tractor shall operate for a period of 2 h subsequent to a sufficiently long warming-up period for power to become stabilized.

The maximum power quoted in the report shall be the average of the readings made during the 2-h period. If the power variation deviates by more than 2% from the average, the test shall be repeated. If the variation continues, the deviation shall be stated in the report.

No fewer than six readings shall be made during the 2-h test period, evenly spread, over the period.

Data recorded shall include engine crankshaft revolutions per minute, dynamometer revolutions per minute, mechanical power outlet shaft revolutions per minute, coolant temperature, wet- and dry-bulb air temperatures, fuel consumed, and dynamometer torque. Speeds of engine mechanical power outlet, and dynamometer shall be taken simultaneously. The barometric pressure shall be recorded at the beginning of the run and at 1 h intervals thereafter.

5.1.1.3 *Test at Full Load and Varying Speed*—The hourly fuel consumption, torque, and power are measured as a function of speed down to an engine speed at least 15% below the speed at maximum torque.

5.1.1.4 *Tests at Varying Load*—The governor control is set for maximum power at each of these conditions:

a. At rated engine speed
b. At standard power takeoff speed (540 or 1000 rpm)

Torque, engine speed, and hourly fuel consumption shall be recorded at the following loads:

5.1.1.4.1 The torque corresponding to maximum power available at rated engine speed and at standard power takeoff speed.

5.1.1.4.2 85% of the torque obtained in 5.1.1.4.1;

5.1.1.4.3 75% of the torque defined in 5.1.1.4.2;

5.1.1.4.4 50% of the torque defined in 5.1.1.4.2;

5.1.1.4.5 25% of the torque defined in 5.1.1.4.2;

5.1.1.4.6 Unloaded (with the brake disconnected if the residual torque is greater than 5% of 5.1.1.4.2).

5.1.1.5 *Related Measurements*—In addition to the performance measurements required, the following shall also be noted:

5.1.1.5.1 Temperature of the fuel at a suitable point between the tank and the engine, and the oil temperature at a suitable point in the oil flow.

5.1.1.5.2 The coolant temperature at the outlet of the cylinder block or cylinder head before the thermostat or, in the case of air-cooled engines, the engine temperature at a point specified by the manufacturer.

5.1.1.5.3 The air temperature measured at two points: one approximately 2 m in front of the tractor, approximately 1.5m above the ground, and the other at the engine air intake.

5.1.1.5.4 Atmospheric pressure.

5.1.1.5.5 Relative air humidity.

*5.1.1.6* *Graphical Presentation of Results*—The test report shall include presentation of the following curves made for the full range of engine speed available:

5.1.1.6.1 Power as a function of speed (with standard PTO speed indicated).

5.1.1.6.2 Equivalent crankshaft torque as a function of speed (except for fluid transmissions).

5.1.1.6.3 Hourly and specific fuel consumption as a function of speed.

5.1.1.6.4 Specific Fuel Consumption as a Function of Power—These curves will be derived from test results under 5.1.1.2, 5.1.1.3, and 5.1.1.4.

*5.1.1.7* *Special Cases of Tractors with a Power Takeoff Unable to Transmit the Full Power from the Engine*—The foregoing tests at the main power takeoff are made when the total available power may be transmitted by the main power outlets.

If the total available power cannot be transmitted by the main PTO, the engine must be tested as shown in 5.1.1.8.

In addition, the power takeoff shall be tested, distinguishing between the type of coupling:

5.1.1.7.1 Mechanical Coupling Between Engine and Power Takeoff—A 2 h power takeoff test will be made at the maximum power specified by the manufacturer with a 20% overload applied every 5 min for a period not exceeding 1 min. If the engine does not develop the 20% overload, the intermittent overload shall be carried out at full engine power and this fact shall be noted in the test report. The maximum power reported for the 2 h test will be that specified by the manufacturer.

5.1.1.7.2 Nonmechanical Coupling Between Engine and Power Takeoff—In the case of a fluid or electrical power transmission system with its possible cooling component, the following test conditions and procedures shall apply:

5.1.1.7.2.1 Test Conditions—In addition to those required under 5.1.1.7.1, a means shall be provided for measuring the temperature(s) of any nonmechanical components which couple the engine to the power takeoff system.

5.1.1.7.2.2 Test Procedure—The governor control level being set for maximum power, the system shall be operated at maximum PTO power for a period sufficient to establish stabilized conditions but not less than 2 h. The PTO system shall be considered stable when two consecutive temperature readings of the cooling device taken 10 min apart do not differ by more than 1 °C.

The tractor shall then operate for a period of 1 h. The maximum power quoted in the report shall be the average of a minimum number of six readings evenly spread. If the PTO or the engine speed deviates by more than 2% from the standard PTO speed or calculated average speed, respectively, the test shall be repeated. If the variation continues, the deviation shall be stated in the report. The temperature observed at the critical components of the system shall also be recorded.

A second 1 h test shall be made at the PTO power level observed previously and at the lowest engine speed which will maintain this power at the rated PTO speed.

A third series of tests shall determine PTO powers at part loads with the governor control set as for the second test. Each test shall last at least 20 min and shall be made according to 5.1.1.4.

*5.1.1.8* *Engine Tests Made in Addition to or in Place of the Main Power Takeoff Tests*—For tractors with no power takeoff or with a power takeoff unable to transmit the full power of the engine, the tested engine shall be equipped with all the accessories, including the cowling, required for continuous operation of the tractor and shall be installed in the same relative position to them as when installed in the tractor.

The dynamometer shall be coupled directly to the crankshaft or to some other suitable power outlet which shall be stated in the test report.

All the tests listed as tests at the main power takeoff will be made (5.1.1.2, 5.1.1.3, and 5.1.1.4) except those at the standard power takeoff speed will not be made for tractors with no power takeoff.

5.1.2 HYDRAULIC POWER AND LIFTING FORCE

*5.1.2.1* *Test Conditions*—The hydraulic fluid shall be as recommended by the manufacturer and identified by type, viscosity, and classification (see ISO 3448/1975). The governor control lever shall be set for maximum power at rated engine speed. At the start of each test, the temperature of the hydraulic fluid in the tank shall be measured and shall be 65 °C ± 5 °C. If this cannot be achieved, the temperature measured during the test shall be stated in the test report. A pressure gage shall be fitted immediately next to the external tapping of the tractor.

*5.1.2.2* *Hydraulic Power*—The pump delivery rate shall be measured using a designated auxiliary service coupling with measuring equipment causing negligible pressure drop in the external line.

The following results shall be reported:

5.1.2.2.1 The pressure sustained by the open relief valve or with the pump stalled, in the case of a closed-center system with pressure-compensated variable delivery pump.

5.1.2.2.2 The pump delivery rate at minimum pressure.

5.1.2.2.3 The hydraulic power available at the designated 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.

5.1.2.2.4 The maximum hydraulic power available at the auxiliary service coupling and the corresponding oil flow and hydraulic pressure.

5.1.2.2.5 The opening and closing pressures of the unloading valve for a closed-center system having an accumulator.

*5.1.2.3* *Lifting Force*

5.1.2.3.1 Additional Conditions—The tractor shall be so secured that the tires are not deflected by the reactive force of the power lift. The linkage shall be adjusted in the same way both with and without the coupled frame to achieve typical and repeatable arrangements as follows:

5.1.2.3.1.1 The linkage shall be adjusted in accordance with the tables in ISO 730/1-1977, ISO 730/2-1979, and ISO 730/3-1982. For those tractors which do not achieve the standard power range, the lift force will be measured at the maximum achievable power range.

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

5.1.2.3.1.3 Where more than one upper or lower link point is available on the tractor, the points used shall be specified by the manufacturer and shall be included in the test report.

5.1.2.3.1.4 Where there is more than one attachment point to connect the lift rods to the lower links, the connection points used shall be specified by the manufacturer and shall be included in the test report.

5.1.2.3.1.5 These initial adjustments, as far as possible, shall cause the mast to turn through a minimum of 10 degrees from the horizontal to the uppermost position. If this is not possible, the fact shall be stated in the test report.

NOTE—Oil pressure shall be checked during the test.

5.1.2.3.2 Lift at the Lower Hitch Points—An external vertical downward force shall be applied to a horizontal bar connecting the lower hitch points. This force shall remain as vertical as possible in the median plane of the tractor throughout the lift range. If necessary, the values of measurement will need to be corrected.

5.1.2.3.2.1 The lifting force available and the corresponding pressure of the hydraulic fluid shall be determined at a minimum of six points approximately equally spaced throughout the range of movement of the lift, including one at each extremity. At each point the force shall be the maximum which can be exerted against a static load. Additionally, the range of movement shall be measured. The pressure recorded during the test must exceed the minimum relief valve pressure setting.

5.1.2.3.2.2 The values of force measured shall be corrected to correspond to a hydraulic pressure equivalent to 90% of the actual relief valve pressure setting of the hydraulic lift system. The corrected value of the lowest lifting force constitutes the maximum vertical force which can be exerted by the power lift throughout its full range of movement.

5.1.2.3.3 Lift on a Coupled Frame—A frame having the following characteristics shall be attached to the three-point linkage:

5.1.2.3.3.1 The mast height and the distance from the hitch points to the centerline of the tractor shall be appropriate to the linkage category as defined by ISO (see 5.1.2.3.1.1). Where more than one category is specified, that chosen for the test shall be at the manufacturer's option.

5.1.2.3.3.2 The center of gravity shall be at a point 610 mm to the rear of the lower hitch points, on a line at right angles to the mast and passing through the middle of the line joining the lower hitch points.

Testing conditions and procedure shall be as in 5.1.2.3.2. The mass of the frame shall be added to the force applied.

5.1.2.3.4 Test Report—The following results shall be reported:

5.1.2.3.4.1 The maximum corrected vertical force at the lower hitch points and at the center of gravity of the standard frame as a function of the lifting heights measured with respect to the horizontal lower links for the whole range of movement of the lift.

5.1.2.3.4.2 The full range of vertical movement of the respective points of application of the force (see 5.1.2.3.2).

5.1.2.3.4.3 The pressure equivalent to 90% of the actual relief valve pressure setting.

5.1.2.3.4.4 The pressure corresponding to maximum power delivered by the hydraulic system.

5.1.2.3.4.5 The height of the lower hitch points above the ground in their lowermost position and without load.

5.1.2.3.4.6 The angle through which the mast turns from the vertical to the uppermost position.

5.1.2.3.4.7 The main linkage dimensions and the mast height of the frame relative to the centerline of the rear wheels as tested.

5.1.2.3.4.8 The temperature of the hydraulic fluid at the start of each test.

5.1.2.3.4.9 The calculated moment around the rear axle, resulting from the maximum external lift force at the frame which can be exerted through the full range of movement.

5.1.3 DRAWBAR POWER

*5.1.3.1* *General Requirements*—During all the tests at the drawbar, the governor control shall be set for maximum power. Tests shall not be made in gears in which the forward speed will then exceed the safety limits of testing equipment.

The line of draft shall be horizontal. The height of the drawbar shall remain fixed in relation to the tractor during each test. It shall be chosen by the manufacturer in such a way that the direction of the tractor can be controlled when it develops maximum pull.

In the case of wheeled tractors, if:

a. W is the static weight exerted by the front wheels on the ground
b. Z is the wheelbase
c. P is the maximum drawbar pull
d. H is the static height above ground of the line of draft

then the product PH shall never exceed 0.8 WZ.

When testing four-wheeled drive tractors with a differential connection between driving axles, the drawbar height must be selected so as to keep adhesion consistent between front and rear wheels when the drawbar pull reaches its maximum.

5.1.3.1.1 This test may be carried out on one or more sets of tires of different sizes, and the several results included in the test report.

The tractor tire and wheel or track equipment shall conform to the manufacturer's recommendations.

5.1.3.1.2 At the beginning of the drawbar tests, the height of the tire tread bars shall not be less than 65% of the height of the bars of the tires when new. The height of the tire tread bars shall be measured by use of a three-point gage. The gage shall be placed astride the tread bar and perpendicular to the direction of the tread bar, as close to the centerline of the tire as possible. Two legs of the gage shall be positioned at the base of the tread bar (at the point of tangency between the tire carcass and the radius joining the tread bar to the carcass). The third point of the gage shall be in the center of the tread bar. The tread bar height shall be the difference in elevation between the two outside legs of the gage and the center point. The tread bar height measured in this manner shall be averaged for a minimum of four equally spaced locations around the periphery of the tire. It shall be compared to similar data on a new tire of the same make, size, and type.

The effective circumference of the drive wheels or tracks shall be determined by driving the tractor over the drawbar test runway or runways and counting the revolutions of each drive wheel or track. The tractor shall be driven at low speed, without drawbar pull, and with all ballast in place (if ballast is used).

5.1.3.1.3 For wheeled tractors, performance values only up to 15% mean wheel slip shall be reported. As the no-slip distance will vary according to the degree of wear of the tires it will be necessary to check this regularly, particularly before determining maximum drawbar power. With steel track-laying tractors the maximum drawbar pull, together with the corresponding track slip, and also the point corresponding to 7% track slip shall be stated as a footnote beneath the table giving drawbar power values.

5.1.3.1.4 For each gear at the maximum power in that gear, the engine speed, power, drawbar pull, travel speed, slip of wheels or tracks, fuel consumption, temperature of fuel, coolant and lubricating oil, and the atmospheric conditions shall be recorded.

5.1.3.1.5 During tests the atmospheric temperature shall not exceed 35 °C.

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

5.1.3.1.7 For tractors with an infinitely variable transmission, the drawbar power envelope curve shall be obtained by determining the maximum powers for a sufficient number of transmission ratios to enable an accurate envelope curve to be drawn. Power values shall then be reported, read off from this envelope at the following speeds:

Wheeled tractors:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| km/h | 2.5 | 3.5 | 5.0 | 6.5 | 8.0 | 11.0 | 17.5 |

Track-laying tractors:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| km/h | 1.5 | 2.5 | 3.5 | 5.0 | 6.5 | 8.0 | 10.0 |

In addition, for tractors with infinitely variable transmissions the following data read off the curve shall be reported:

a. Maximum power, fuel consumption, and corresponding speed
b. Maximum power and corresponding drawbar pull with traveling speed control and engine governor control in the position giving maximum speed

*5.1.3.2* *Drawbar Power Test (Unballasted Tractor)*—Tests will determine the power available at the drawbar of the unballasted tractor over a range of speeds.

Tests shall be made at least in those gears giving a travel speed faster than in the gear in which the greatest maximum power is developed to that immediately below the gear allowing maximum pull to be developed.

*5.1.3.3* *Drawbar Power Test (Ballasted Tractor)*—A second test series shall be performed on the tractor, ballasted in accordance with the manufacturer's specifications. The tests shall cover all gears from that giving the lowest travel speed to that giving a travel speed faster than in the gear in which the greatest maximum power is developed.

*5.1.3.4 Ten-Hour Test (Wheeled Tractors)*

5.1.3.4.1 Wheeled tractors on pneumatic tires, ballasted as for 5.1.3.3 will be tested for 5 h in the gear designated by the manufacturer, in agreement with the testing station. This speed shall be one normally used for basic agricultural work such as plowing but as far as possible a different gear group from that used in 5.1.3.4.2. The drawbar load applied shall be 75% of the pull at maximum power in the gear being used. Values of power, pull, forward speed, slip, and fuel consumption shall be included in the report.

For tractors fitted with a hydrokinetic torque converter that can be "locked-out" by the driver, the 5 h test shall be carried out with the torque converter in operation, within the limitations specified by the manufacturer in his published instructions. If the limiting conditions are reached, the test shall be completed with the torque multiplier out of operation; the respective durations of the two parts of the test shall be noted in the report and the fuel consumption separately stated.

5.1.3.4.2 Following test 5.1.3.4.1, with a cooling interval between, wheeled tractors on pneumatic tires will be tested for a further 5 h at the drawbar pull giving 15% wheel slip measuring during test 5.1.3.3. The gear used shall be the fastest gear in which the required pull can be obtained when the engine is operating under the control of the governor.

Supplementary ballast may be added to reduce tire wear and to have proper control of the tractor. Pull, forward speed, temperatures, and atmospheric conditions shall be recorded.

Tractors fitted with a hydrokinetic torque converter that can be "locked-out" by the driver shall be treated as in 5.1.3.4.1.

5.1.3.4.3 During the 10 h of these two tests the engine lubricating oil consumption shall be measured and expressed in units of mass per hour.

*5.1.3.5 Ten-Hour Test (Other Tractors)*—For track-laying and steel-wheeled tractors one test of 10 h shall be made as otherwise specified in 5.1.3.4.1 to replace tests 5.1.3.4.1 and 5.1.3.4.2. This test shall be carried out in two 5 h periods, with a cooling interval between.

5.1.4 TURNING AREA AND TURNING CIRCLE—These measurements shall be made on a test track as in the test at the drawbar. The tractor track setting shall be one commonly used in the country in which the test is made and shall be stated. The tractor shall be unballasted and moving slowly (approximately 2 km/h).

Tests shall be made turning right and left, with and without using the steering brakes.

5.1.5 POSITION OF CENTER OF GRAVITY—This shall be determined with full tanks and the driver replaced by a weight of 75 kg on the driver's seat, the tractor being otherwise unballasted.

5.1.6 BRAKING (WHEELED TRACTORS ONLY)

*5.1.6.1 Test Conditions*—The performance of service braking devices shall be based on the mean deceleration calculated over the stopping distance. The stopping distance shall be the distance covered by the tractor from the moment when the driver begins to actuate the control of the device until the moment when the tractor stops.

The performance of parking braking devices shall be based on the ability to hold the tractor stationary, facing up and down slopes.

The braking performance shall be measured during road tests conducted under the following conditions:

5.1.6.1.1 The tractor mass shall be as prescribed for each type of test and be specified in the test report.

5.1.6.1.2 The braked axle wheels shall be fitted with the highest load capacity tires used in normal agricultural work.

5.1.6.1.3 The road shall have a surface affording good adhesion.

5.1.6.1.4 The test shall be performed when there is no wind liable to affect the results.

5.1.6.1.5 At the start of the tests the tires shall be cold and at the pressure prescribed for the load on the wheels when the tractor is stationary.

5.1.6.1.6 The performance shall be measured without locking the wheels.

5.1.6.1.7 During the tests the tractor shall be fitted with any parts intended by the manufacturer for the operation of towed vehicle braking devices.

*5.1.6.2 Cold Service Braking Device Test*

5.1.6.2.1 The brakes must be cold at the beginning of the test. A brake is deemed to be cold if any of the following conditions are met:

5.1.6.2.1.1 The temperature measured on the disc or on the outside of the drum is below 100 °C.

5.1.6.2.1.2 For totally enclosed brakes, including oil immersed brakes, the temperature measured on the outside of the housing is below 50 °C.

5.1.6.2.1.3 The brakes have not been actuated for 1 h.

5.1.6.2.2 During the braking test, an unbraked axle, when capable of being declutched, shall not be connected with a braked axle.

5.1.6.2.3 The test shall be conducted under the following conditions:

5.1.6.2.3.1 The tractor shall be ballasted to its maximum mass with an unbraked axle also loaded to its technically permissible maximum mass; for tractors braking on all wheels, the front axle shall be laden to its technically permissible maximum mass.

5.1.6.2.3.2 The test shall be repeated on the unballasted tractor carrying only the driver and, if necessary, a person responsible for monitoring the results of the test.

5.1.6.2.3.3 The road shall be level.

5.1.6.2.4 With the tractor traveling on its maximum speed or 50 km/h ± 10%, whichever is less, a measured force shall be applied to the control of the service braking device and the resulting stopping distance measured.

Where possible, the engine shall be declutched from the driven axles when applying the brakes. If this is not possible, the engine speed control shall be moved to the minimum engine speed position when applying the brakes.

The stopping distance for a series of values of force applied to the control of the braking device shall be recorded and the corresponding values of mean deceleration calculated from Equation 3:

$$f = V^2/2S \quad \text{(Eq. 3)}$$

where:

f= Mean deceleration ($m/s^2$)
V = Initial speed (m/s)
S = Stopping distance (m)

Sufficient values shall be obtained to establish the relationship between mean deceleration and force applied to the braking control device. The force shall vary between zero and the force at which the braked wheels lock. If the braked wheels do not lock, the effect of forces up to 600 N shall be recorded.

The relationship between mean deceleration and force applied to the braking control device shall be reported as either a graph or a table of corresponding values.

Deviation of the tractor from its original course and any abnormal vibration during braking shall also be reported.

*5.1.6.3* *Fade Test (Ballasted Tractor Only)*—As a first method, the tractor shall be towed for 1 km at 80% ± 5% of its maximum speed, with, if possible, the engine disengaged from the driven axles and the service brake applied such that the towing force is 10% of the maximum tractor weight.

As an alternative, the tractor shall be driven for 1 km at 80% ± 5% of its maximum speed. The service brake shall be actuated with that force which has given a mean deceleration of 1 $m/s^2$ in the preliminary brake tests with cold brakes. The governor control lever has to be set at the start of the drive. The initial speed shall be maintained throughout the drive by actuation of the service brake.

Immediately after heating the brakes by one of the two procedures, the cold service braking device test shall be repeated without allowing the brake to cool.

The report shall state which method of heating the brakes was used.

*5.1.6.4* *Parking Brake Device Test*—The force necessary to apply at the parking brake control device to hold the tractor stationary when facing up and down an 18% gradient when ballasted to its maximum weight shall be measured.

The measurements may be made either on a sloping road or by applying a pull to the tractor on a level road.

If it is necessary to actuate the parking braking device control several times in order to hold the tractor stationary, the maximum force applied shall be recorded.

5.1.7 EXTERNAL NOISE LEVEL (WHEELED TRACTORS ONLY)

*5.1.7.1* *Test Conditions*

5.1.7.1.1 Measuring Equipment—A precision quality sound level meter shall be used meeting the requirements of publication No. 651 of the International Electrotechnical Commission (IEC). Measurement shall be carried out with a frequency weighting network in conformity with curve A and set to give fast response as is described in the IEC publication.

The equipment shall be calibrated frequently and, if possible, before each measuring session.

An adequate technical description of measuring equipment shall be given in the test report.

5.1.7.1.2 General Requirements—Measurement will be made on the unballasted tractor with no load, in a sufficiently silent and open zone (ambient noise and noise of wind 10 dB less than the noise to be measured). For example, this zone may be an open space of 50 m radius, of which the central part of at least 20 m radius shall be practically level and made of concrete, asphalt, or similar material and shall not be covered with powdery snow, high grass, friable soil, or cinders.

The surface of the track shall be of such a kind that pneumatic tires do not cause excessive noise.

Measurements shall be made in fine weather with little or no wind. Any extraneous noise occurring during the reading, which is not connected to general sound level measurement, shall not be taken into consideration.

5.1.7.1.3 Stabilized Speed to be Used—The stabilized speed to be used will be equal to three-quarters of the attainable maximum in the gear giving the highest speed used for road work.

*5.1.7.2 Sound Level Test*—At least two measurements shall be carried out on each side of the tractor. Preliminary measurements to establish governor control setting may be made, but shall not be taken into consideration.

The microphone shall be placed 1.2 m above ground and at a distance of 7.5 m from the axis of forward movement of the vehicle, measured along the perpendicular PP′ to this axis.

Two lines AA′ and BB′ parallel to the line PP′ and situated respectively 10 m in front and behind this line, shall be marked on the test track. Vehicles shall be driven at stabilized speed, under the conditions specified hereafter, as far as line AA′. At this moment, the governor control lever shall quickly be fully opened. The lever shall be held in this position until the vehicle has passed line BB′ and then brought to the opposite position as quickly as possible.

Measurements shall be considered valid if the difference between the two consecutive measurements on the same side of the tractor is not greater than 2 dB. The value shall be that corresponding to the highest sound level.

## 5.2 Optional Tests

5.2.1 ENGINE—This test can be carried out to supplement the main tests.

*5.2.1.1 Test Conditions*—Any accessory which is not necessary for the continuous operation of the engine, such as the hydraulic lift pump or air compressor, shall be disconnected, if possible.

The alternator or generator, with no load, shall remain connected and all other components necessary for the operation of the engine in the tractor such as air cleaner, exhaust muffler, and fan shall remain in operation.

When an optional supplementary engine test is undertaken, the provisions for main power takeoff tests shall be modified, so that measurements are also made under part-load conditions at reduced engine speeds.

*5.2.1.2 Test Results*—Sufficient data shall be obtained to relate specific fuel consumption, power, torque, and engine speed throughout the working range of the engine. The results shall 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 may be shown respectively as percentage values of the rated speed and the torque at rated speed. The results shall also be presented in a table as shown in the Specimen Test Report.

5.2.2 PERFORMANCE AT THE BELT OR THE BELT PULLEY SHAFT

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

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

All of the provisions for tests at the main power takeoff, with the exception of those at standard power takeoff speed and for tractors unable to transmit the full engine power at the power takeoff, shall apply to the belt tests and to the pulley shaft tests.

If the engine speed recommended by the manufacturer for tests at maximum power does not correspond to a standard belt speed, the operational characteristics of the engine at the speed corresponding to the standard belt speed shall be measured during the full load test.

*5.2.2.2* *Test Results*—The power, hourly fuel consumption, and specific fuel consumption in relation to engine speed shall be recorded.

5.2.3 PERFORMANCE IN A HOT ATMOSPHERE

*5.2.3.1* *Test Conditions*—These tests must be made at a temperature regulated to ±2 °C. The tractor is coupled to a dynamometer as in the power takeoff tests.

During the tests the following temperatures are taken: water temperature at the cylinder block before the thermostat or, in the case of an air-cooled engine, temperature at the point prepared by the engine manufacturer to hold the temperature-sensing device; air temperature at the cooling system inlet; engine oil temperature; air temperature at the air cleaner inlet; and fuel temperature.

*5.2.3.2* *Test Procedure*—A first series of tests takes place with the governor control lever set for maximum power at the rated speed of the engine.

The temperatures of the cooling system and engine oil, at maximum engine power and under stable conditions are recorded as a function of the ambient temperature which will be taken as being the temperature of the air entering the cooling system.

Before taking readings all temperatures must be stabilized. The ambient temperature limit for running the tractor is the temperature at which the engine achieves its temperature limit in running, determined either by the boiling of the cooling water or by obtaining the maximum temperature at the insertion point of the safety thermostat specified by the manufacturer, or yet again by obtaining the maximum temperature fixed by the manufacturer for the engine oil. The approximate value of the ambient temperature limit is worked out graphically by extrapolating the engine temperature curves (cooling system or oil temperature). The power loss is determined in the same way, being expressed as a percentage of maximum power obtained in the main PTO tests.

If the power takeoff speed at maximum power is more than 25% greater than at standard speed, the test shall be repeated at that speed.

5.2.4 LOW-TEMPERATURE STARTING

*5.2.4.1 Test Conditions*—The test shall determine the lowest temperature at which the engine is able to start.

5.2.4.1.1 Fuel—The complete fuel system shall be filled with the appropriate grade of fuel for operation at the test temperature. If prior to the test the engine has been operating on another fuel, new filter elements shall be fitted and care shall be taken in draining fuel from all components of the fuel system, flushing and filling with the appropriate test fuel, and finally running the engine to ensure that the system is free of air.

The following data on the fuel used shall be recorded: type, density at 15 °C, octane or cetane number, and pour point.

Attention is drawn to the different specifications of the fuel oils used in temperature and cold climates. For example, the pour points of the former might be -12 °C and the latter -36 °C.

5.2.4.1.2 Lubricating Oil—The engine and transmission lubricating systems shall be filled with the appropriate grades of oil for operation at the test temperature. If prior to the test the tractor has been operating with grades of oil appropriate to other temperatures, care shall be taken in draining these, then flushing and filling with the appropriate oil(s). The oil level(s) shall be checked after running the engine for a few minutes and topped off if necessary before commencing the test.

5.2.4.1.3 Starting System

5.2.4.1.3.1 Electrical—The batteries shall be fully charged and then discharged for 3 h at the 10-h rate to produce a 70% charged condition prior to the test. Battery terminals and leads shall be checked for good condition.

5.2.4.1.3.2 Potential Energy Storage Types (Mechanical, Hydraulic, etc.)—Where appropriate two tests shall be carried out. In one the storage system shall be charged before the soaking period, and in the other it shall be charged immediately prior to the starting attempt, if this is possible.

5.2.4.1.4 Cooling System—With water-cooled systems, antifreeze solution of the appropriate strength shall be used.

5.2.4.1.5 Starting Aids—All systems to aid starting shall be checked for correct operation before the start of the test.

*5.2.4.2 Test Procedure*—The tractor shall be placed and maintained in an environment held at the test temperature for 15 h immediately prior to the starting attempt.

Starting shall be attempted using the normal procedure recommended by the manufacturer. A start shall be deemed successful when the engine runs smoothly for 10 s, without aid from the starter or thermal device. In this test, five attempts within a period of 5 min are permissible. With electric starting this stipulation may be waived if the entrant prefers some other technique in the use of the energy available from the battery. If the five attempts are unsuccessful, the tractor shall be moved to a temperate environment, started, and run until the normal operating temperature has been reached. The tractor shall then be returned to soak at a higher temperature for a further 15 h for the next series of attempts. If, on the other hand, the engine starts, the same procedure shall be followed at a lower temperature. The process shall be repeated until the lowest temperature at which the engine is able to start is found.

The entrant shall have the option to nominate his operator for starting attempts.

***6. Test Procedures—Restricted Code***

**6.1 Main Power Takeoff—**All requirements, conditions, procedures, and tests shall be the same as in 5.1.1.

**6.2 Hydraulic Power and Lifting Force—**All requirements, conditions, procedures, and tests shall be the same as in 5.1.2.

**6.3 Drawbar Power**

6.3.1 GENERAL REQUIREMENTS—During all tests at the drawbar, the governor control shall be set for maximum power except in 6.3.3.4 and 6.3.3.5. All other requirements, conditions, procedures, and tests shall be the same as in 5.1.3.1.

6.3.2 DRAWBAR POWER TEST (UNBALLASTED TRACTOR)—All requirements, conditions, procedures, and tests shall be the same as in 5.1.3.2.

6.3.3 FUEL CONSUMPTION TEST (UNBALLASTED TRACTOR)—In order to provide information on operational efficiency at part loads, fuel consumption shall be measured in gears typically used for field work, selected by the manufacturer in agreement with the testing station. Two gears shall be selected for runs 6.3.3.1, 6.3.3.2, and 6.3.3.3, one having a nominal speed nearest to 7.5 km/h and the other where the highest power is developed.

Measurements of engine speed, power, drawbar pull, travel speed, slip of wheels or tracks, fuel consumption, temperatures of fuel, coolant and lubricating oil, and atmospheric conditions must be made at:

*6.3.3.1* Maximum drawbar power available in the selected gear.

*6.3.3.2* A pull equal to 75% of the pull corresponding to maximum power at rated speed.

*6.3.3.3* A pull equal to 50% of the pull corresponding to maximum power at rated speed.

*6.3.3.4* Reduced engine speed in the next higher gear showing a lower fuel consumption with the same pull and traveling speed as in 6.3.3.2.

*6.3.3.5* Reduced engine speed in the next higher gear showing a lower fuel consumption with the same pull and traveling speed as in 6.3.3.3.

NOTE—With some small tractors, tests 6.3.3.4 and 6.3.3.5 may be impossible. This fact must be stated in the report.

**6.4 Optional Tests—**Other individual tests from Section 5 may be performed as additions to the tests under Section 6.

***7. Reporting of Results—***All information shall be published in either the SI (System Internationale, see SAE TSB 003) units and U.S. customary units, or the SI units only.

**7.1** Appendix A details the specifications of the tested tractor to be supplied by the manufacturer or checked by the testing station, or both. Items concerning ballast and a ballasted tractor can be omitted with performing only the Restricted Code tests.

**7.2** Appendix B details the data and format for results of the various tests performed. Either the Standard Code or Restricted Code drawbar performance data sheet is chosen according to the type of test performed.

PREPARED BY THE SAE AGRICULTURAL TRACTOR TECHNICAL COMMITTEE

## APPENDIX A

## SPECIMEN TEST REPORT

NOTE—SI units (ISO 1000-1981) should be stated first, followed by national units in parentheses, if necessary.

a. Tractor manufacturer's name and address
b. Location of tractor assembly
c. Submitted for test by
d. Selected for test by
e. Place of running-in
f. Duration of running-in: h
g. Location of test

### *A.1 Specifications of Tractor*

#### A.1.1 Tractor

a. Make/Model/Type
b. Number of driving wheels
c. Serial No.
d. 1st Serial No.

#### A.1.2 Engine

a. Make/Model/Type
b. Serial No.

A.1.2.1 CYLINDERS

a. Number/disposition
b. Bore/stroke: mm/mm
c. Capacity: $cm^3$
d. Compression ratio
e. Arrangement of valves
f. Cylinder liners (wet or dry)

A.1.2.2 SUPERCHARGING

a. Make/Model/Type
b. Pressure: MPa

A.1.2.3 FUEL SYSTEM

a. Fuel feed system
b. Make/Model/Type of fuel filter(s)
c. Capacity of fuel tank: $dm^3$
d. Make/Model/Type of injection pump
e. Serial No.
f. Manufacturer's production setting of injection of pump
   1. Flow rate (rated engine speed and full load): $dm^3/h$
   2. Timing
g. Make/Model/Type of injectors
h. Injection pressure: MPa

i. Make/Model/Type of carburetor

A.1.2.4 GOVERNOR

a. Make/Model/Type
b. Governed range of engine speed from _____ to _____: rpm
c. Rated engine speed: rpm

A.1.2.5 AIR CLEANER

a. Precleaner
   1. Make/Model/Type
   2. Location of air intake
b. Main cleaner
   1. Make/Model/Type
   2. Location of air intake (in case of no precleaner)
c. Maintenance indicator

A.1.2.6 LUBRICATION SYSTEM

a. Type of feed pump
b. Type of filter(s)
c. Number

A.1.2.7 COOLING SYSTEM

a. Type of coolant
b. Type of pump
c. Specification of fan or blower
d. Number of fan blades
e. Fan diameter: mm
f. Coolant capacity: $dm^3$
g. Type of temperature control
h. Superpressure system: kPa

A.1.2.8 STARTING SYSTEM

a. Make/Model/Type
b. Starter motor power rating: kW
c. Cold starting aid
d. Safety device

A.1.2.9 ELECTRICAL SYSTEM

a. Voltage: V
b. Generator/Alternator
   1. Make/Model/Type
   2. Power: kW

c. Battery (Number of accumulators)
   1. Rating: _____ A-h at _____ hours

A.1.2.10 EXHAUST SYSTEM

a. Make/Model Type
b. Location

**A.1.3 Transmission to Wheels**

A.1.3.1 CLUTCH (TRAVEL AND POWER TAKEOFF/TRAVEL ALONE)

a. Make/Model/Type
b. Number of plates
c. Diameter of plates: mm
d. Method of operation

A.1.3.2 GEAR BOX

a. Make/Model/Type
b. Arrangement
c. Number of gears
d. Available options

A.1.3.3 REAR AXLE AND FINAL DRIVES

a. Make/Model/Type
b. Differential lock
   1. Type
   2. Method of engagement
   3. Method of disengagement

A.1.3.4 FRONT AXLE AND FINAL DRIVES

a. Make/Model/Type
b. Differential lock
   1. Type
   2. Method of engagement
   3. Method of disengagement

A.1.3.5 TOTAL RATIOS AND TRAVELING SPEEDS—See Figure A1.

| Gear No. | Group | Number of Engine Revolutions for One Revolution of the Driving Wheels | Nominal Traveling Speed(*) at Rated Engine Speed of _____ rpm km/h |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| (*) Calculated with a tire dynamic radius index of _____ mm (ISO 4251/1-1984). | | | |

FIGURE A1—TOTAL RATIOS AND TRAVELING SPEEDS

A.1.3.6 Number of Revolutions of Front Wheels for One Revolution of Rear Wheels (4WD Tractors)

**A.1.4 Power Takeoff**

A.1.4.1 MAIN POWER TAKEOFF

a. Type (independent, semi-independent, or not independent)
b. Method of engagement (if necessary, describe the type of clutch)
c. Number of shafts
d. Method of changing power takeoff shaft ends and speeds

A.1.4.2 POWER TAKEOFF PROPORTIONAL TO ENGINE SPEED

*A.1.4.2.1* 540 rpm

a. Location
b. Diameter of power takeoff shaft end: mm
c. Number of splines (in conformity/not in conformity with ISO 500-1979)
d. Height above ground: mm
e. Distance from the median plane of the tractor: mm
f. Distance behind rear wheel axle: mm
g. PTO speed at rated engine speed (_____ rpm): rpm
h. Engine speed at standard power takeoff speed: rpm
i. Ratio of rotation speeds (engine speed/PTO speed)
j. Power restriction and maximum torque: _____ kW _____ N·m
k. Direction of rotation (viewed facing driving end)

*A.1.4.2.2 1000 rpm*

a. Location
b. Diameter of power takeoff shaft end: mm
c. Number of splines (in conformity/not in conformity with ISO 500/1979)
d. Height above ground: mm
e. Distance from the median plane of the tractor: mm
f. Distance behind rear wheel axle: mm
g. PTO speed at rated engine speed (_____ rpm): rpm
h. Engine speed at standard power takeoff speed: rpm
i. Ratio of rotation speeds (engine speed/PTO speed)
j. Direction of rotation (viewed facing driving end)

A.1.4.3 POWER TAKEOFF PROPORTIONAL TO GROUND SPEED

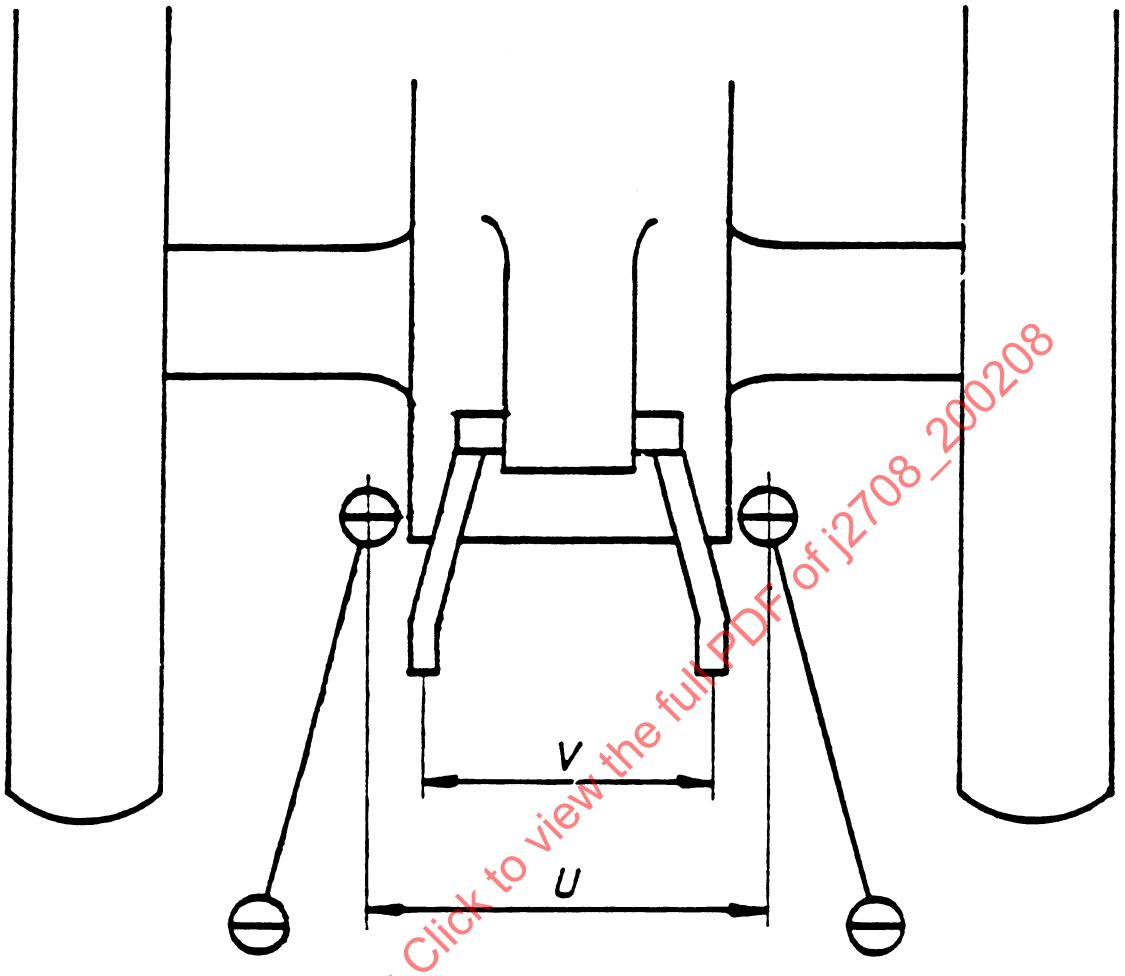
a. Indicate 540 or 1000 rpm
b. Traveling distance for one revolution of power takeoff shaft: m
c. Number of power takeoff shaft revolutions for one revolution of (rear) driving wheels
d. Direction of rotation with forward gear engaged (viewed facing driving end)

A.1.4.4 OPTIONAL POWER TAKEOFF

a. Give the same description as for the main PTO

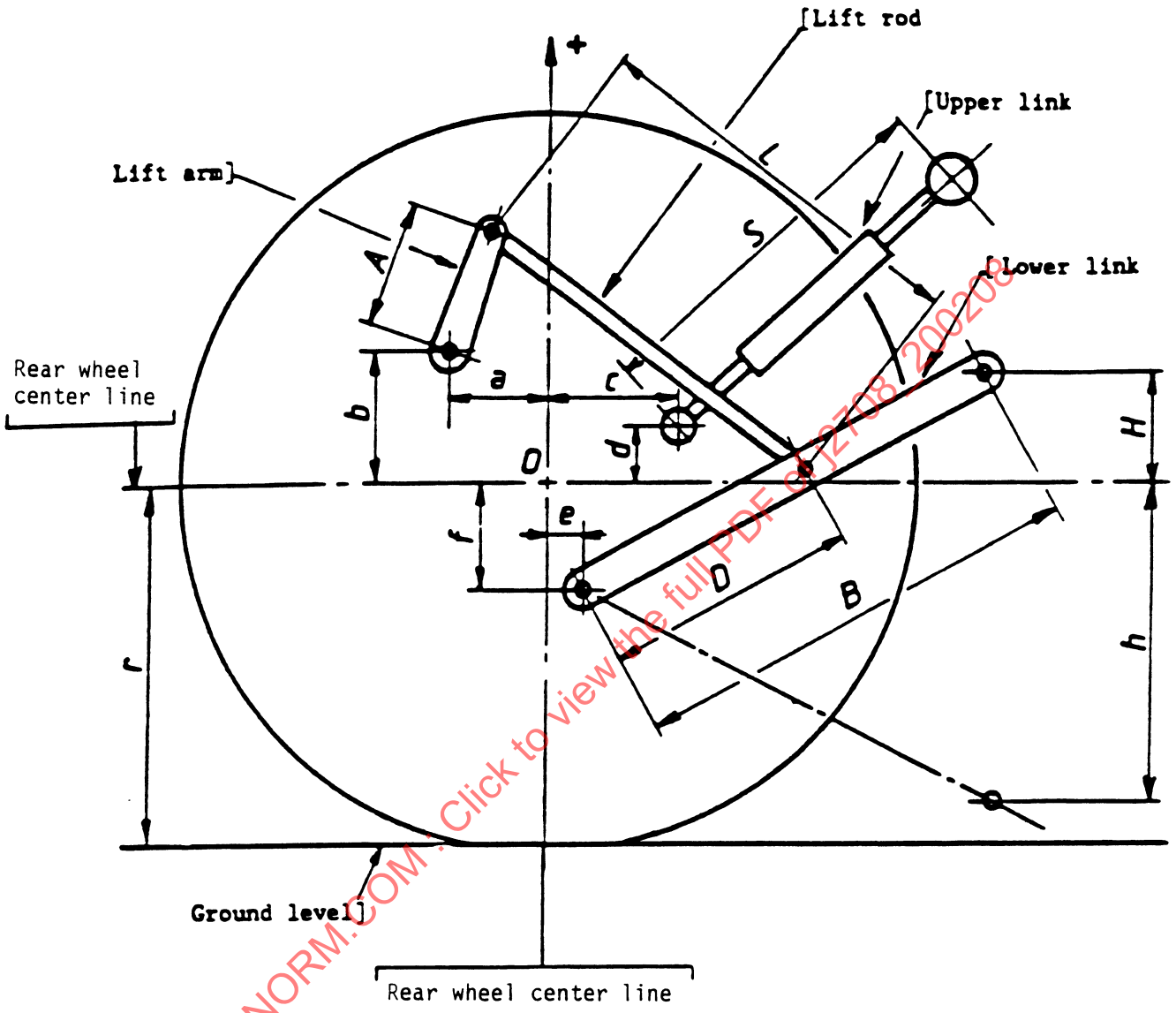
**A.1.5 Power Lift—**(See Figures A2 and A3.)

a. Make/Model/Type
b. Type of hydraulic system
c. Type and number of cylinders (single- or double-acting)
d. Type of linkage lock for transport
e. Relief valve pressure setting (tolerance): MPa (±MPa)
f. Opening pressure of cylinder safety valve (if fitted): MPa
g. Lift pump type
h. Transmission between pump and engine
i. Type and number of filters
j. Site of oil reservoir
k. Type, number, and location of tapping points
l. Maximum volume of oil available to external cylinders: $dm^3$




Give detailed figures of power lift and complete Table A1 with values corresponding to the dimensions of the figure.

FIGURE A2—LIFT TEST—LINKAGE GEOMETRY




Give detailed figures of power lift and complete Table A1 with values corresponding to the dimensions of the figure.

FIGURE A3—LIFT TEST—LINKAGE GEOMETRY

A.1.5.1 THREE-POINT LINKAGE

a. Category: _____ (in conformity/not in conformity with categories 1, 2, 3, 4, 1N) (ISO 730/1-1977, ISO 730/2-1979, ISO 730/3-1982)
b. Category adapter

Give detailed figures of power lift and complete Table A1 with values corresponding to the dimensions of the figure.

Give detailed figures of power lift and complete Table A1 with values corresponding to the dimensions of the figure.

**TABLE A1—DIMENSIONS OF LINKAGE GEOMETRY (WHEN CONNECTED TO THE STANDARD FRAME)**

| | | Dimension or Range mm | Settings Used in Test mm |
|---|---|---|---|
| Length of lift arms | (A) | _____ | _____ |
| Length of lower links | (B) | _____ | _____ |
| Distance of lift arm : horizontally | (a) | _____ | _____ |
| Pivot point from rear : vertically wheel axis | (b) | _____ | _____ |
| Horizontal distance between the 2 lower link points | (u) | _____ | _____ |
| Horizontal distance between the 2 lift arm end points | (v) | _____ | _____ |
| Length of upper link | (S) | from _____ to | _____ |
| Distance of upper link : horizontally | (c) | _____ | _____ |
| Pivot point from rear : vertically wheel axis | (d) | from _____ to | _____ |
| Distance of lower link : horizontally | (e) | _____ | _____ |
| Pivot point from rear : vertically wheel axis | (f) | from _____ to | _____ |
| Distance of lower link pivot points to lift rod pivot points on lower links | (D) | from _____ to | _____ |
| Length of lift rods | (L) | from _____ to | _____ |
| Height of lower hitch points relative to the rear wheel axis: | (h) | from _____ to | _____ |
| - in low position | (H) | from _____ to | _____ |
| - in high position | | | |
| Height above ground of lower hitch points when locked in transport position(*) | | from _____ to | _____ |

(*) Assuming r = dynamic radius index (ISO 4251/1-1984).

### A.1.6 Swinging Drawbar

a. Type
b. Height above ground

1. Maximum: mm
2. Minimum: mm

c. Type of adjustment
d. Distance of hitch point from rear wheel axis, horizontally: mm
e. Distance of hitch point from power takeoff shaft end

1. Vertically: mm
2. Horizontally: mm

f. Lateral adjustment (center of clevis)

1. Right hand: mm
2. Left hand: mm

g. Distance of pivot point from rear wheel axis, horizontally: mm
h. Diameter drawbar pin hole: mm
i. Maximum vertical permissible load: kN

### A.1.7 Trailer Hitch

a. Type
b. Hole diameter: mm
c. Height above ground: mm
d. Distance of hitch point from rear wheel axis, horizontally: mm
e. Distance of hitch point from power takeoff shaft end

1. Vertically: mm
2. Horizontally: mm

f. Distance of hitch point from power takeoff shaft end

1. Vertically: mm
2. Horizontally: mm

g. Maximum vertical permissible load: kN

### A.1.8 Holed Drawbar

a. Number of holes
b. Distance between holes: mm
c. Hole diameter: mm
d. Thickness/width of the drawbar: mm/mm
e. Height above ground

1. Minimum: mm
2. Maximum: mm

f. Horizontal distance to power takeoff shaft end (rear): mm

**A.1.9 Steering**

a. Make/Model/Type
b. Method of operation

1. Pump/s
2. Ram/s

c. Working pressure: MPa

**A.1.10 Brakes**

A.1.10.1 SERVICE BRAKE

a. Make/Model/Type
b. Method of operation
c. Trailer braking takeoff (hydraulic or air brake)

A.1.10.2 PARKING BRAKE

a. Type
b. Method of operation

**A.1.11 Wheels—**See Figure A4.

a. Number

1. Front: driving/steering
2. Rear: driving/steering

b. Wheelbase: mm
c. Track width adjustment

| | Minimum mm | Maximum mm | Adjustment Method |
|---|---|---|---|
| Front | | | |
| Rear | | | |

FIGURE A4—WHEELS

**A.1.12 Protective Structure**

a. Make/Model/Type
b. Manufacturer's name and address
c. Protective device

1. Cab/frame/rollguard/other
2. Tiltable/not tiltable

d. OECD approval number

**A.1.13 Driver's Seat**

a. Make/Model/Type
b. Type of suspension
c. Type of damping
d. Range of adjustment

1. Longitudinal: mm
2. Vertical: mm

**A.1.14 Miscellaneous**

a. Additional seat

1. Location
2. Number of places

**A.1.15 Lighting—**See Figure A5.

| | Height Above Ground of Center mm | Size mm | Distance from Outside Edge of Tractor to Median Plane mm |
|---|---|---|---|
| Headlights | | | |
| Sidelights | | | |
| Rearlights | | | |
| Reflectors | | | |

FIGURE A5—LIGHTING

**A.1.16 Test Conditions—**Additional tables may be necessary for other test conditions.

A.1.16.1 OVERALL DIMENSIONS (UNBALLASTED TRACTOR)

a. Length: mm
b. Width

1. Minimum: mm
2. Maximum: mm

c. Height

1. Top of protective structure: mm
2. Top of exhaust: mm

A.1.16.2 GROUND CLEARANCE (UNBALLASTED TRACTOR)

a. Clearance-limiting part

A.1.16.3 TRACTOR MASS (WITH OR WITHOUT FRAME/ROLLGUARD/CAB/OTHER)—See Figure A6.

| | | Without Driver kg | With Driver kg |
|---|---|---|---|
| Unballasted | Front | | |
| | Rear | | |
| | Total | | |
| Ballasted | Front | | |
| | Rear | | |
| | Total | | |
| Ballast | | | |

| | Number of Weights | Mass (Total) kg | Water kg |
|---|---|---|---|
| Front | | | |
| Rear | | | |
| Additional | | | |

FIGURE A6—TRACTOR MASS (WITH OR WITHOUT FRAME/ROLLGUARD/CAB/OTHER)

A.1.16.4 DIMENSIONS OF TRACKS FOR TRACK-LAYING TRACTORS

A.1.16.5 TIRES AND TRACK WIDTH SPECIFICATIONS—See Figure A7.

Additional tables may be necessary for other test conditions (other tire equipment).

| | Front Wheels | Rear Wheels |
|---|---|---|
| - Tires: | | |
| . Dimensions | | |
| . Ply rating | | |
| . Type | | |
| . Maximum load (tire manufacturer's) (kN) | | |
| . Maximum load (tractor manufacturer's) (kN) | | |
| . Inflation pressure (tire manufacturer's) (kPa) | | |
| . Dynamic radius index (mm) | | |
| - Chosen track width (mm) | | |

FIGURE A7—TIRES AND TRACK WIDTH SPECIFICATIONS FORM

A.1.16.6 OILS AND LUBRICATION

a. Capacity and change interval (see Figure A8)
b. Specifications (SAE, API, MIL-L, ISO) (see Figure A9)

| | Capacity $dm^3$ | Oil Change h | Filter Change h |
|---|---|---|---|
| Engine | | | |
| Gear box | | | |
| Front axle | | | |
| Rear axle | | | |
| Final drive (front) | | | |
| Final drive (rear) | | | |
| Hydraulic system (*) | | | |
| Other (steering, etc.) | | | |
| (*) State if common with gear box or rear axle. | | | |

FIGURE A8—CAPACITY AND CHANGE INTERVAL FORM

| | Recommended | Used During Test |
|---|---|---|
| Engine oil | | |
| . Type | | |
| . Viscosity | | |
| . Classification | | |
| Transmission oils | | |
| . Type | | |
| . Viscosity | | |
| . Classification | | |
| Hydraulic fluid | | |
| . Type | | |
| . Viscosity | | |
| . Classification | | |
| Steering oil | | |
| . Type | | |
| . Viscosity | | |
| . Classification | | |
| Grease | | |
| . Number of lubrication points | | |

FIGURE A9—SPECIFICATIONS (SAE, API, MIL-L, ISO)

A.1.16.7FUEL

a. Type (in conformity, not in conformity with national standard)
b. Density at 15 °C _____ $g/cm^3$