

AIS-042

AUTOMOTIVE INDUSTRY STANDARD

**Agricultural Tractors -
Steering Effort Requirements**

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ON BEHALF OF :

AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER

CENTRAL MOTOR VEHICLE RULES - TECHNICAL STANDING COMMITTEE

SET-UP BY

MINISTRY OF ROAD TRANSPORT & HIGHWAYS

GOVERNMENT OF INDIA

January 2004

Status chart of the Standard to be used by the purchaser for updating the record

Sr. No.	Corr-igenda.	Amend-ment	Revision	Date	Remark	Misc.

General Remarks:

Introduction

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the Ministry of Surface Transport (MoST) has constituted a permanent Automotive Industry Standard Committee (AISC) vide order No.RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the Secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their Web site.

There is a need to specify the test procedure and performance criteria for normal and emergency steering modes and the steering effort for agricultural tractors under CMVR.

The detailed test procedure and the requirements of test instrumentation have to be specified clearly for anybody who carries the steering effort evaluation.

The AISC panel responsible for formulation of this standard is given in Annexure: I

The Automotive Industry Standards Committee (AISC) responsible for preparation of this standard is given in Annexure : II

Agricultural Tractors - Steering Effort Requirements

1.0 SCOPE

- 1.1 This Automotive Indian Standard specifies the test procedure and performance criteria for normal and emergency steering modes and steering effort for agricultural wheeled tractors.
- 1.2 The requirements in this Standard do not imply that additional devices are mandatory if the tractor energy source fails. However, if the tractor is equipped with these devices, then the requirements are mandatory.

NOTE 1: All wheels of the tractor may be steered wheels.

2.0 REFERENCE

- 2.1 The following Indian / ISO Standards are necessary adjunct to this standard.
 - 2.1.1 ISO 789-11 - 1) Agricultural tractors - Test procedures - Part 11: Steering capacity of wheeled tractors.
 - 2.1.2 ISO 10998 - 1995, Agricultural Wheeled tractors - steering requirements.
 - 2.1.3 IS 10703 - 1992, Agricultural Tractors - Maximum actuating forces required to operate controls.

3.0 DEFINITIONS

For the purposes of this Standard, the following definitions apply.

- 3.1 **Agricultural tractor:** Any mechanical propelled four wheeled vehicle designed to work with suitable implements for various field operations and / or transport agricultural material. Agricultural tractor is a non transport vehicle.
- 3.2 **Steering equipment:** All equipment needed to maintain or alter the direction of tractor movement.
 - 3.2.1 **Steering -Control:** That part directly operated by the driver to maintain or alter the direction of tractor movement.
 - 3.2.2 **Steering-Wheel:** Type of steering control (3.2.1) that is generally round and alters the direction of movement by rotary motion.
 - 3.2.3 **Steered Wheels:**
 - 1) Wheels the alignment of which may be altered directly or indirectly in relation to the tractor in order to obtain a change in the direction of movement of the tractor.

- 2) All wheels of articulated tractors.
- 3) Wheels on the same axle, the speed of which may be varied in order to obtain a change in the direction of movement of the tractor.

3.2.4 **Steering Gear:** All the components between the steering control and the steered wheels, with the exception of the tractor energy source (3.2.5).

NOTE 2: The steering gear may be mechanical, hydraulic, pneumatic, electric or a combination of any of these.

3.2.5 **Tractor Energy Source:** Part of the steer equipment which supplies additional or independent power to the steering system.

NOTE 3: Additional or independent power may be reduced by any mechanical, hydraulic, pneumatic or electric system, or by any combination of these (for example by a oil pump, air pump or battery, etc.)

3.3 Type of steering equipment

3.3.1 **Manual Steering Equipment:** Equipment in which the steering power of the deflection of steered wheels is provided solely by the muscular power of the driver.

3.3.2 **Assisted Steering Equipment:** Equipment in which the steering power for the deflection of the steered wheels is provided both by the muscular power of the driver and by the tractor energy source (3.2.5).

NOTE 4: Steering equipment where the steering power for the deflection of the steered wheels is normally provided solely by the tractor energy source (3.2.5) but which in the event of failure of the tractor energy source enables the muscular power of the driver to be used for steering, is considered as assisted steering equipment.

3.3.3 **Servo-Steering Equipment:** Equipment in which the steering power for the deflection of the steered wheels is provided solely by the tractor energy source (3.2.5).

3.4 **Steering Effort:** Force applied tangentially to the average outside radius of the steering-wheel by the driver to steer the tractor.

3.5 **Turning Diameter:** Diameter of the circular path described by the centre of tyre contact with the surface of the test site of the wheel describing the largest circle.

3.6 **Turning Radius:** Radius of the circular path described by the centre of tyre contact with the surface of the test site of the wheel describing the largest circle.

4.0 GENERAL REQUIREMENTS

4.1 **Steering-wheel:** The steering-wheel shall be easy to use and grip. It shall be designed in such a way as to permit gradual deflection. The direction of movement of the top of the steering-wheel shall correspond to the desired change in the direction of the tractor.

4.2 Steering Gear:

4.2.1 The steering gear shall contain only mechanical parts or meet the provisions of this International Standard for mechanical steering gear which is assisted by hydraulic, electrical or pneumatic components. It shall be possible to steer the moving tractor even in the event of a failure of any of these assisting components.

The steering gear shall be so designed as to meet any operational requirements, and be easily accessible for maintenance and inspection.

4.2.2 Steering gear which is operated purely hydraulically and the tractor energy source defined in 3.2.5 shall meet the following requirements.

One or more pressure-limitation device shall protect the whole or part of the circuit against excess pressure.

The pressure-limitation device shall be set so as not to exceed the maximum operating pressure p stated by the manufacturer.

The characteristics and dimensions of the conduits shall be able to withstand four times the maximum operating pressure p stated by the manufacturer.

The characteristics and dimensions of the conduits shall be withstand four times the maximum operating pressure p (permitted by the pressure-limitation devices), and shall be protected in places and arranged in such a way that the risk of damage by impact or interference are reduced to a minimum and where the risk of damage by rubbing can be considered negligible.

4.3 **Test Area:** The test area shall be a compacted or paved dry surface affording good tyre adhesion, capable of displaying legible marking, and resistant to defacement by turning tractors. The test surface shall be visually flat, with not more than 3% grade in any direction. The test area shall be large enough to accommodate the test tractor as it negotiates the appropriate tests.

4.4 **Test tractor tyres and wheel equipment:** The tyres, wheels and fender equipment used for the test shall be those which create the highest loading in the steering equipment (as specified by the manufacturer) when the direction of movement of the tractor is altered. This is usually , but not always, with the largest diameter tyres.

The tyres, wheels and fender equipment used on the test tractor shall be stated in the test report (see Annexure A). Tyre pressure, tractor ballast, any use of front or rear dual wheels, and the mass on each axle shall be recorded.

5.0 APPARATUS, MEASUREMENT UNITS AND TOLERANCES

5.1 Apparatus

5.1.1 Device to measure turning radius.

5.1.2 Device to measure steering radius.

5.1.3 Device to measure elapsed time.

5.1.4 Measurement units and tolerances

The following units and tolerances are used in this part of ISO 789:

- a) time, in seconds : + 0,2 s
- b) distance, in meters or millimeters: + 0,5 %
- c) force, in new tons: + 1 %
- d) mass, in kilograms: + 0,5 %
- e) pressure, in kilopascals: + 2 %

6.0 TEST

6.1 Tractor specifications: All component parameters related to steering capability shall be within the manufacturer's specifications. Tractors with the option of different tyres sizes shall be tested with the arrangement which requires the highest steering effort. This is created by using tyres with the maximum load carrying capacity for the maximum design speed specified by the manufacturer.

Tractors shall be ballasted to the manufacturer's limit for overall tractor mass, with ballast distributed within the manufacturer's allowable limits to provide the highest steering effort.

Tyre inflation pressure shall be within the range recommended by the manufacturer for driving on the road at maximum design speed. Front wheel drive that can have the front wheel drive manually or automatically disconnected shall be tested in the disconnected mode. Differential locks shall not be engaged unless they are automatic, in which case they shall be left in the automatic mode.

6.2 Test Procedure: Drive the tractor in a spiral line at a speed of $10 \text{ km/h} \pm 2 \text{ km/h}$ starting from the straight ahead position. Start the time measuring device. A turn shall be initiated from the straight ahead position and the steering effort maintained on the steering -wheel unit the tractor reaches a position corresponding to a 12 m turning radius as shown in Figure 1. Record the time taken to reach this position and the steering effort.

One complete test shall be made turning only to the left and a second test turning only to the right. If the tractor is equipped with a tractor energy source as defined in Clause 3.2.5 then simulate a failure of the source by disconnecting the power source and repeat the tests. Turning radius measurement can be made with a marking device or by measuring the actual turning diameter.

7.0 STEERING PERFORMANCE REQUIREMENTS

The tractor shall be able to execute the steering manoeuvres within the following limits.

- 7.1 For normal steering, the steering effort required to perform the test manoeuvres shall not exceed 25 kg and the duration to achieve the specified turning radius shall not exceed 8 s.
- 7.2 For assisted steering equipment that is not connected to other equipment, if the tractor energy sources fails, the steering effort required shall not exceed 60 kg and the duration to achieve the specified turning radius shall not exceed 8 s.
- 7.3 For assisted steering equipment with a hydraulic connection between the hydraulic steering equipment and hydraulic braking equipment, if both are supplied from the same tractor energy source, and if either of the systems should fail, the steering effort required shall not exceed 40 kg and the duration to achieve the specified turning radius shall not exceed 8 s.

8.0 ADDITIONAL REQUIREMENTS FOR SPECIFIC TYPES OF STEERING EQUIPMENT:

- 8.1 **Assisted Steering Equipment:** If the tractor is equipped with assisted steering equipment, it shall be possible to steer the tractor in the event that the tractor energy source fails. If the assisted steering equipment does not have its own source of power, it shall be fitted with a power supply to the steering equipment with priority over the other systems which are linked to the tractor energy source.

Where the steering power is normally provided solely by the tractor energy source defined in 3.2.5, the assisted steering equipment shall be fitted with a visual or acoustic signal which will warn if the tractor energy source has failed and the steering effort exceeds 250 N.

- 8.2 **Servo-Steering Equipment:** If the tractor is fitted with servo-steering equipment and provided that such equipment has a wholly hydraulic steering gear, then should the tractor energy source fail, or a main engine failure causes the tractor energy source to be inoperative, it shall be possible to carry out the two manoeuvres specified in Clause 6.2 using a special additional device. The special additional device may be a compressed air or gas reservoir, or an oil pump or compressor with a

dedicated power source. In the event of failure of the special additional device, a visual or acoustic signal shall give warning of such failure. A similar signal shall be provided for the special additional device to indicate the status (readiness) of the device during the tractor start-up process. The status indicator requirement does not apply where the special additional device is worked by the rotation of the tractor wheels and cannot be disconnected from them.

If the special additional device is pneumatic, it shall be fitted with a compressed air reservoir protected by a non-return valve. The capacity of the compressed air reservoir shall be calculated so that at least seven complete turns of the steering-wheel from full lock to full lock are possible before the reservoir pressure falls to half its operating pressure, this shall be tested with the steered wheels off the ground.

9.0 TEST REPORT

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

- a) the name and address of the manufacturer
- b) the type and model of tractor
- c) tractor mass and ballast description
- d) tractor drive
- e) tractor tyre sizes and pressures, in kilopascals
- f) steering characteristics
- g) test conditions
- h) data on steering effort, and time to achieve a 12 m turning radius.

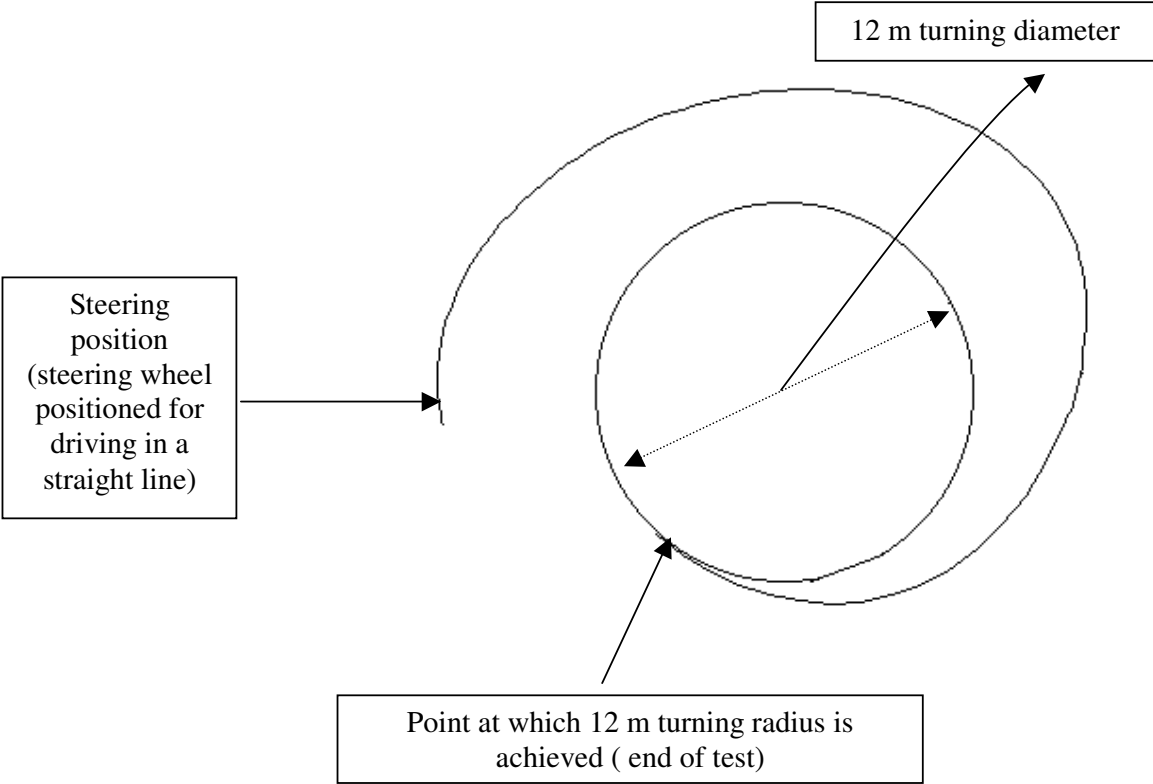


Figure 1 - Steering course

Annexure: A

Specimen test report

A.1 Tractor

Manufacturer's name and address:
.....

Tractor make:

Model:.....

Mass of tractor submitted for test (including ballast):

Front:kg Rear:

Total:kg

Description of ballast:kg

A.2 Track (tread) setting

Table with 3 columns: Nominal, Actual front, Actual rear. Rows for mm measurements.

A.3 Drive wheels

Two wheel
Four wheel
Other (describe):
.....

A.4 Tyres and wheels

Table with 3 columns: Tyre size, Singles or duals, Tyre pressure. Sub-columns for Front and Rear.

A.5 Steering equipment Ackermann steer front axle

Articulated

Special equipment:

.....

Type of steering

Manual

Assisted

Servo

Other (describe):

.....

A.6 Test surface

Paved

Compacted soil

A.7 Steering effort and time to achieve 12 m turning radius at 10 km/h

Tractor state	Steering effort "Kg"	Time "s"
With engine running left turn: right turn:		
Simulated tractor energy source failure left turn: right turn:		

Comments:

.....
.....

Measured by:

.....

Tractor location:

.....

Test

date:.....

Annexure : I
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Annexure : II
(See Introduction)
COMMITTEE COMPOSITION
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