

AI 3401 TRACTORS AND ENGINE SYSTEMS

UNIT V NOTES



Procedure of testing and standard code for testing of tractor performance

Introduction

The International Organization for Standardization (ISO) is the apex body in the area of standardization at international level and has its membership on National Standards Bodies of various countries. In the context of farm machinery, it has been observed that acceptance of farm machinery by the farmers largely depends on their quality. Hence, in order to reap the benefits of standardization including manufacture of high quality products, a need was felt for preparation of India Standards for agricultural machinery. Organized efforts in this direction were made by the Bureau of Indian Standards (BIS) in late 50's by way of setting up a Technical Committee for formulation of standards for this group of industry. The committee is generally consisted of representatives of Government department, research, education and testing institutions and the manufacturing industries.

Procedure of testing

BIS. has published standards on machine/components for the machines used in the country. Mostly testing of the particular machine is undertaken as per relevant clauses of the code. In case, the standard has not been published for the machine, code and procedure is developed by the testing center and same used for testing purpose. These test procedures help in formulation of test codes by BIS. The complete testing of a machine involves:

- i. Checking of specifications
- ii. Development of test facilities and instrumentation
- iii. Conduct actual tests
- iv. Analysis of the data
- v. Presentation of data and report writing
- vi. Product certification marks scheme

i. **Checking of specifications:** Generally the test codes include few important specifications of the machine/equipment those are mandatory to meet a specific requirement. Few specifications have to be specified by the manufacturer and the testing center has to verify such dimensions within the tolerance limits.

ii. **Development of facilities and instrumentation:** The test codes give a guide line for development of test set up required for carrying out a specific test in the machine/equipment/component. The testing center has to develop a setup which should meet the requirements specified in the test procedure of the test center. As far as possible the high quality instrumentation should be included in the test set ups.

iii. **Conduct actual tests:** The actual tests should be carried out on the machine as per the test procedure specified and data recorded in the given blank tables.

iv. **Analysis of data:** The data obtained during testing is analyzed for presentation in the required format. Use of computer should be encouraged.

v. **Presentation of data and report writing:** The report should include the sections for the clauses those comply with the standard and those do not conform to the standards.

vi. **Product Certification Marks Scheme:** The Bureau operates a certification marks scheme under the Bureau of Indian standards Act, 1986 and the Rules and regulations framed there under. The Bureau's standard Mark (ISI) on an article certifies that the article complies with the requirements specified in the relevant Indian standards and also guarantees that the manufacturer operates a quality control system in his production which is monitored in terms of regular inspections and checks in such a form as to give assurance that the article will comply with the requirements of the relevant Indian standards. The Certifications Marks schemes also provide an inbuilt mechanism for ensuring the quality of the product right from the raw material stage to the finished product. The BIS Certification Marks Scheme is operated on voluntary basis.

Lab tests

(a) Power test

(i) PTO Test

It measures sustained maximum power, torque and corresponding fuel consumption. The PTO shaft of the tractor is coupled to a dynamometer and gradually loaded. Provision to record fuel consumption, oil temperature Horse Power and torque are available.

he test consists of (a) varying speed test, (b) two hour maximum power test and, (c) varying load test. All the above tests are conducted under normal ambient conditions (27 plus/minus 7 deg. Cas well as under high ambient conditions (43 plus/minus 2 deg. C). From the graphical

representation (Fig. 2) it is clear that the maximum torque is available at a much lower speed which indicates that when the engine is momentary over loaded the speed of the engine will drop and consequently the torque will increase to take care of the momentary over loading. The difference in the values of max. torque and torque at max. power is known as reserve torque or lugging ability of the engine. Better the lugging ability, the better is drawn from performance test are: the tractor. Other information which is drawn

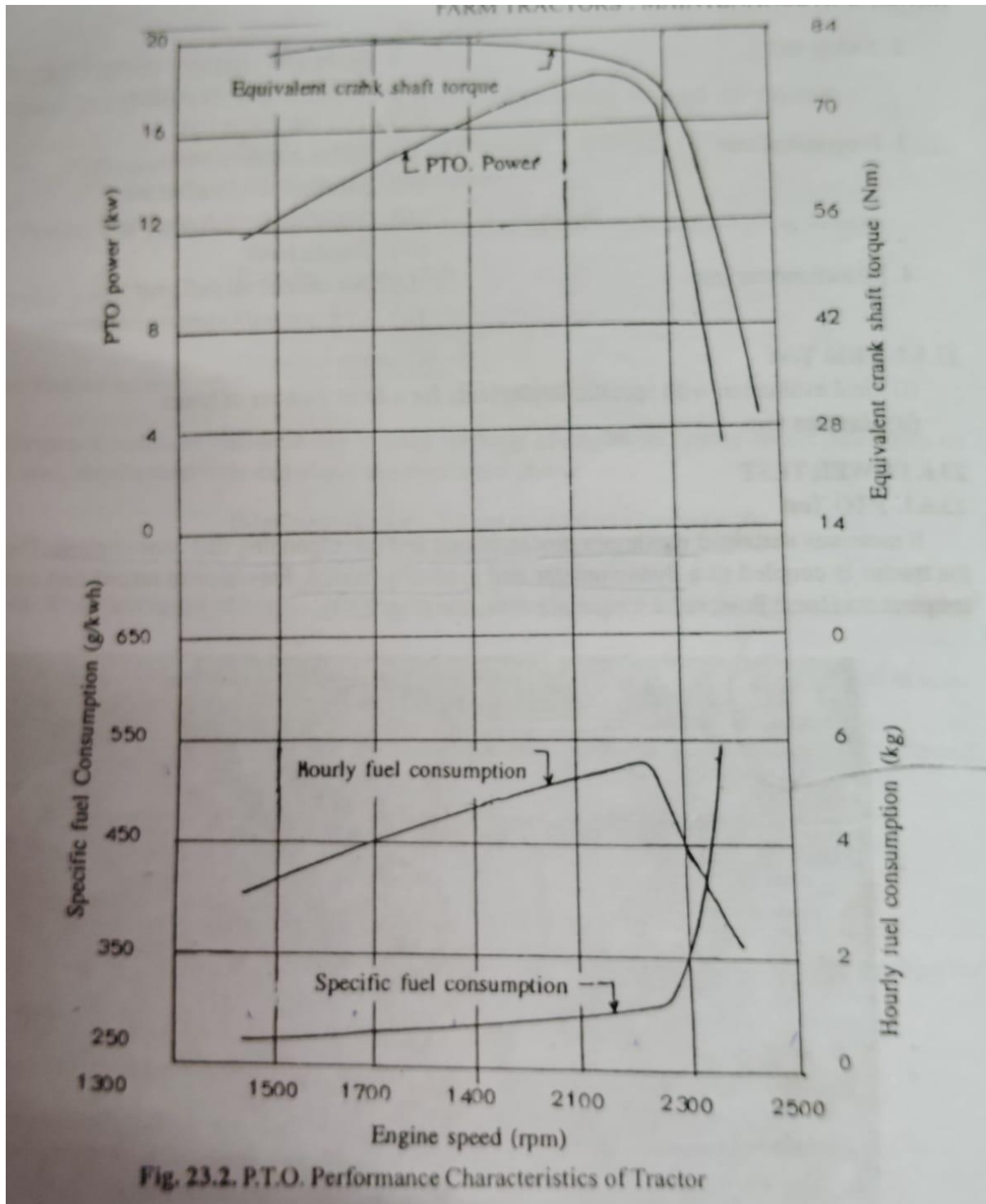
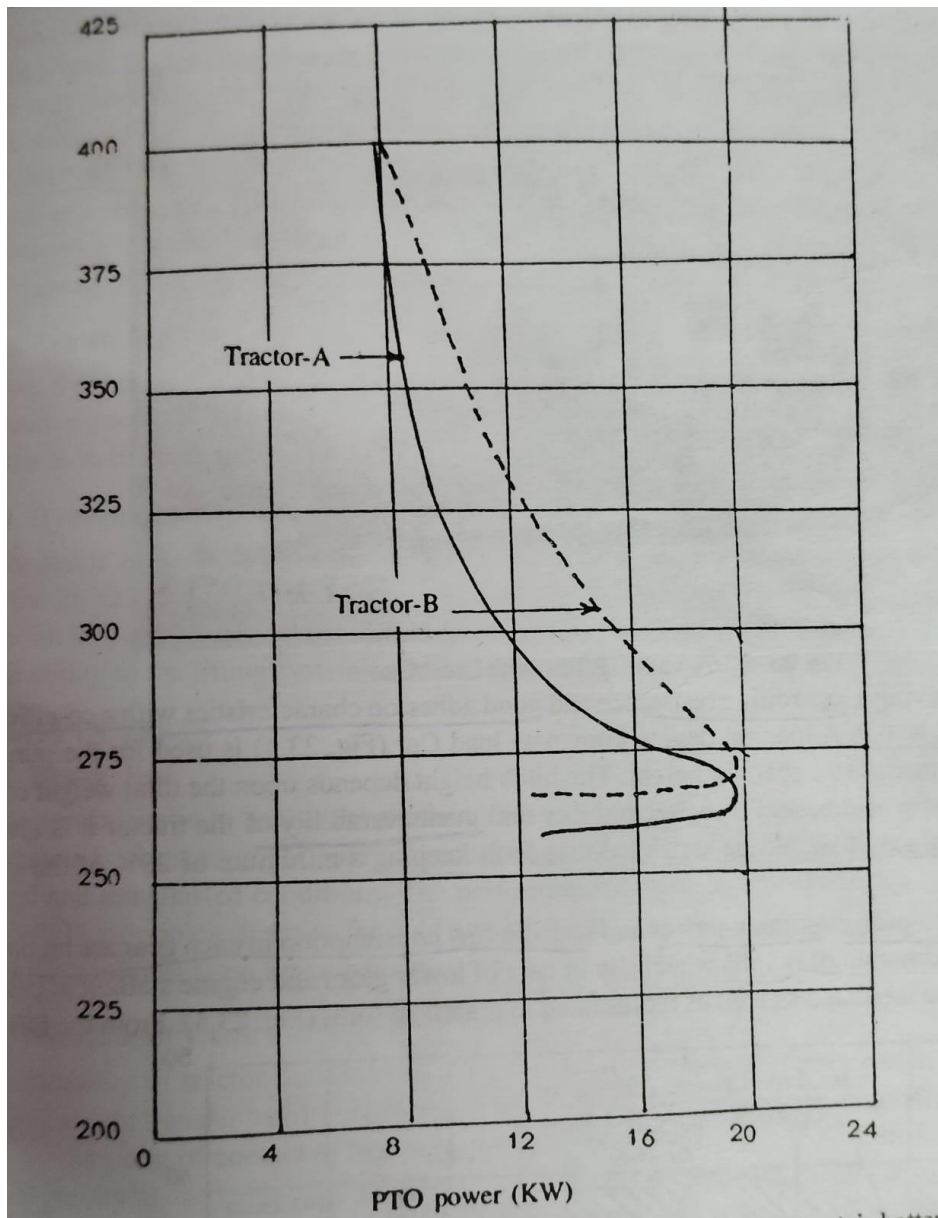


Fig. 23.2. P.T.O. Performance Characteristics of Tractor

Figure 3



(i) Curve drawn between PTO HP and SFC (Fig.3) indicates that if it is flat in the zone of high load it is a better curve. A 'too steep' rise in SFC is not desired.

(ii) The value of SFC corresponding to max. PTO horse power indicates the SFC declaration by the manufacturer.

(iii) The varying load test is to check the proper functioning of the governor. To simulate the conditions under varying load test the tractor is loaded in a pre-determined 'Standard sequence'. The average fuel consumption recorded under varying load test has a practical importance in the sense that this value is nearer to the average fuel consumption during field conditions.

(iv) The results of high ambient test will justify the suitability of the tractor or otherwise in terms of cooling efficiency and oil consumption. Water consumption exceeding 10% of radiator capacity and engine oil consumption exceeding 1% of SFC during Two hours of PTO test are 'undesirable'.

Drawbar Test

The main purpose of drawbar test is to assess the available power and sustained pull at drawbar of tractor in different utility gears. This performance of tractor depends on engine power, tractor weight distribution on drive wheel, type of tyre tread, type of hitch and surface condition. Maximum drawbar power is indication of power of transmission whereas maximum pull is the indication of torque of transmission. This test is conducted over a standard test track so that the results are comparable with other tractors. The 'standard track' is a concrete track having a low rolling resistance and good adhesion characteristics with a co-efficient of traction in between 0.8 to 0.9. A loading device known as load Car (Fig 23.4) is used for the purpose which is connected to the tractor to a specific height. The hitch height depends upon the total weight of the tractor on front wheels and wheel base. For better stability and maneuverability of the tractor it is always necessary that the maximum pull should be restricted to a limit keeping a minimum of 20% of the static weight on front wheels.

The values of maximum pull, maximum power and specific fuel consumption in each gear are recorded. The limiting factor for maximum pull is 15% wheel slip in case of lower gears and engine stalling in case of higher gears. The results are tabulated as well as represented in graphical form (Fig. below). From the DBHP-pull curve of a tractor one can ascertain the gear spacing or gear ratio of the tractor. Lower the gear spacing i.e., the greater the number of gears better is the tractor. The shape of the DBHP pull curve beyond maximum power will reflect the shape of engine-torque curve under engine stall limiting conditions and therefore in case of momentary over loading, the particular gear will take care. However, if the load increases considerably then lower gear is to be selected. The shaded area represents the load range within which the tractor can be operated at a reduced efficiency. The forward speed and the number of speeds at which the given pull can be obtained is also equally important. While comparing two tractors the tractor having less tendency for drop in speed during loading is certainly a good tractor.

Ten Hours Test

The 5 hours rests One a maximum poll generated at 15% wheel slip and another 75% of the pull at ancimen power in the gears normally used for agricultural work are conducted. The purpose of the ten test is to detect any short-comming in the transmission design, maneuverability, steering ability etc.

Hydraulic Power and Lifting Capacity Test

The test is aimed at finding out the maximum static vertical force which can be exerted by the hydraulic lift at the lower hitch points and a point 610 mm to the rear of the hitch points on a frame attached to the three point linkage throughout the full range of movement. The hydraulic pump and relief valve performance and the ability of the lifting system to maintain the load in the lifted position without hydraulic power.

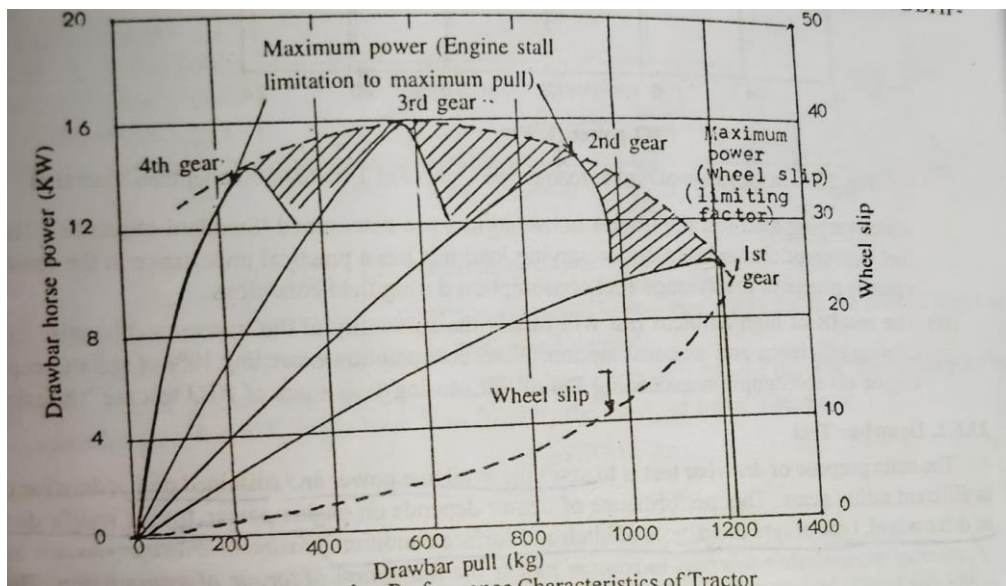


Figure:Draw bar characteristics of Tractor

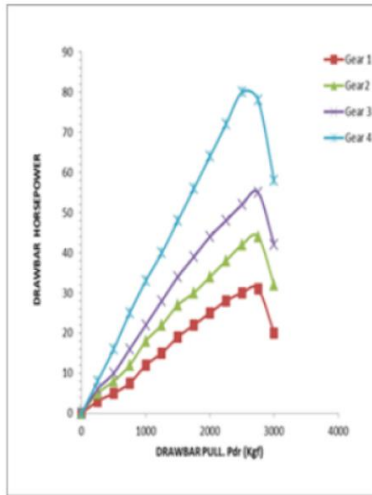


Figure 1 variation of drawbar HP with Drawbar pull for different gear ratios.

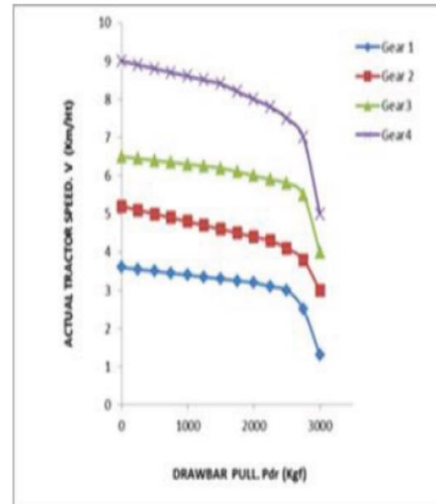


Figure 2 different gear ratio Actual tractor speed with Drawbar pull for different gear ratio.

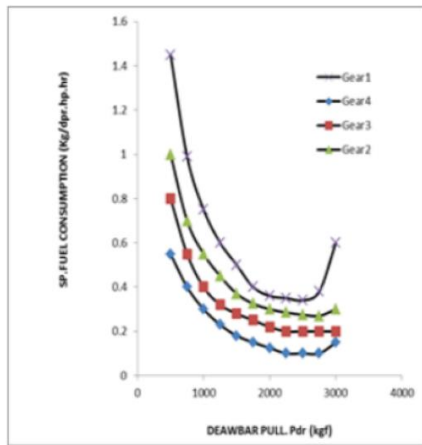


Figure 3 variation of specific full consumption with drawbar pull for different gear ratio

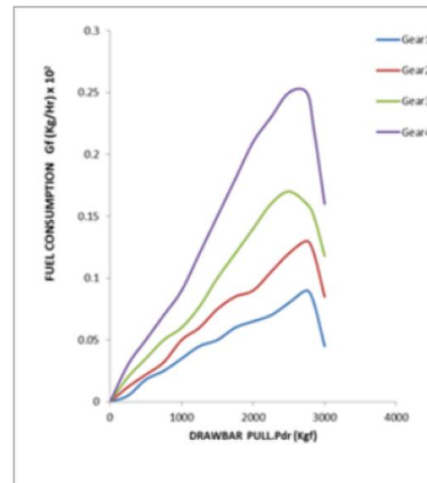


Figure 4 variation of full consumption with drawbar pull for different gear ratio

Brake Test

The test is aimed to assess the performance of service brakes and parking brakes. The service brake performance is checked under cold brake and hot brake conditions at the maximum designed speed under ballasted and unballasted conditions. The performance of parking brakes is checked by parking the tractor on slopes. The stopping distance for cold and hot brake should not exceed 10 meters respectively up to an applied force of 600 N on brake pedals.

Location of Centre of Gravity

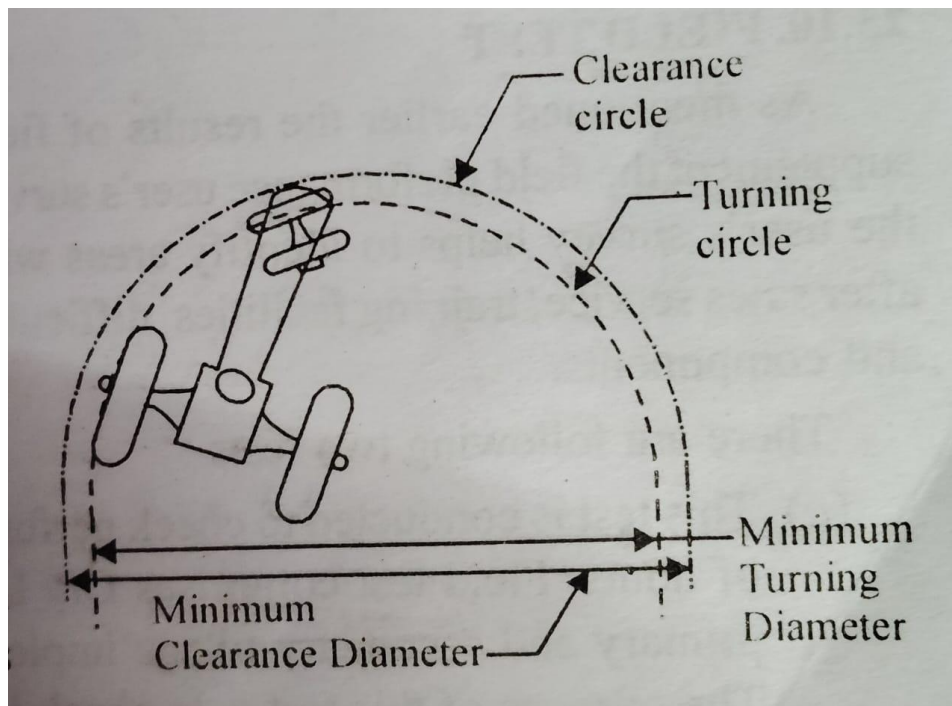
The stability of tractor depends upon the location of centre of gravity which is determined through a method of weight transfer by lifting it. Simple statics dictates that the centre of

gravity falls outside the triangle formed by the point of contact of the two rear wheels and the centre pivot of the front axle. The distance of centre of gravity ahead of rear axle determines the weight distribution, height above the ground determines the stability on grades and during high speed turns. Also with reference to height of rear axle if centre of gravity is below the axle the tractor is better stabilized.

Brake Test

Turning Ability

This aims at measurement of the turning ability and clearance diameter of the unballasted tractor with and without brakes. This would determine the extent of headland to be made available for field operation as shown in figure below.



Ergonomical /Environmental Tests

Mechanical Vibration

This aims at measurement of average amplitude of vibration on an unballasted tractor on points mainly related to operator's comfort. The average amplitude of mechanical vibration at the seat, foot rests and steering wheel should not exceed 100 microns for better operational comfort.

Visibility From Driver's Seat

Keeping the operator's eye level at 760 mm the area invisible is determined around the tractor. The furrow points of the tractor should be visible to the operator from his normal sitting position i.e., within 100 mm of shifting of vision to either side.

Noise Measurement

This is necessary to avoid noise pollution and to protect the operator from fatigue. Noise level is measured at full throttle and on test concrete track, both Ambient noise and Operator's ear level in meteorological conditions. Noise at operator's ear level is conducted at different forward speed gears. In both test noise level limit is 85 dB (A) and 90 dB (A) as specified by ILO (international Labour Organization) respectively.

Smoke Level

The smoke level measured at 80% of maximum power should not exceed light absorption coefficient of 3.25 l/m (5.2 Bosch smoke units or 75 Hartridge smoke units). To control environmental pollution, stringent norms for the mass emission for exhaust gases of tractor and power tiller have been specified by Ministry of Road Surface and Transport, GOI (Trem) Stage III norms w.e.f. 2006).

CO 5.5 g/kWh

Nox + HC 9.5 g/kWh

Pm 0.8 g/kWh

MISCELLANEOUS TESTS

Air Cleaner Oil Pull Over

This aims at finding the percentage of oil pull over to the engine on tractor in horizontal and tilted to 15°. slopes on either side when the air cleaner is filled with additional 5% oil. The oil pull over to the engine should not be more than 0.25%

Component/Assembly Inspection

After the completion of all the laboratory, track tests and field tests the tractor assemblies are dismantled for wear assessment of critical components. The discard limits are supplied by the manufacturer/applicant at the time of submission of the machine for test. Specific reference is

also made to the literature supplied by the applicant/ manufacturer. The premature failures and comparison of components wear in relation to discard limit are highlighted.

(II) Field Test

The results of field tests cannot be compared as such the Institute, in order to supplement the field performance user's survey programme is in operation. In addition to the field performance the over's sarvey helps to identify areas where problems are faced by the actual user owners in terms of after sodes service, training facilities, difficulties encountered in operation and deficiencies in product quality and components

There are following two tests:

(a) This test is conducted to check performance evaluation with matching implement for a fixed number of inors Field test comprises Dry Land and Wet Land operation. Dry land test is conducted withr primary and secondary tillage implements. Wet land test is conducted with rotavator/Case wheel. The purpose of this test is to check ingress of mud or and water in front axle, clutch system, brake system, and contamination of oil in different systems. Suitability of tractor in wet land condition is also important criteria.