# SESSION 2

## Official testing and evaluation of tractors and implements: a tool to assist farmers in assessing performance, safety and environmental factors

**Chairman : Uri M. Peiper, Israel**

**Uri M. PEIPER**
**Israel**

*Good morning to you, and thank you Prof. Pellizzi for the pleasure and honour of chairing this meeting. I recall that many many years ago, back in 1970, it was actually through testing of agricultural machinery that the two of us first met. And just as a little souvenir I have brought along some papers, including your very short CV from that time, it is all in here! Since then we have all gone a little grey - those of us who still have something to go grey! We have all gained a lot of weight and some experience since that time. So it is really my pleasure to chair this meeting on the testing of agricultural machinery, a topic which I worked on for over 20 years before changing job. So without losing too much time I would like to call on the first keynote speaker - Mr. Takahashi.*

# Generality of the official testing system for agricultural machinery

by ***Hiroyuki Takahashi***
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## 1. Role and objectives of official testing

### *1.1 Elimination of poor quality products*

In the initial stages of the agricultural mechanisation process, many poorly designed and poorly manufactured machines may be put on the market. This situation poses serious problems at both the individual and the national level. Official testing of agricultural machinery was started with the primary objective of eliminating poorly designed and poorly manufactured machinery. It must however be remembered that, at the same time, testing tends to upgrade the technical level on the manufacturer's side, thereby contributing to marked improvements in the performance and durability of agricultural machinery.

### *1.2 Guiding appropriate choice and use*

Nowadays, agricultural machinery is essential for farm operations, and huge sums are invested every year on this kind of production equipment. Moreover, the machinery is becoming very complex and sophisticated, and the same time many new models of machinery are being developed. So manufacturers offer various models of any given type of machine. This being the case, choosing appropriate machinery which matches farming and crop/soil conditions, including economic efficiency, and using the machinery efficiently and safely, is a matter of the utmost interest not only to farmers but to society as a whole. IAM-BRAIN does not directly guide or help farmers in choosing appropriate machinery, but plays a role by providing data about machinery test results for this purpose.

### *1.3 Supporting development and improvement*

From the standpoint of the party supplying the machinery, official testing means an evaluation conducted by an impartial and neutral third party. This makes it possible to carry out final checking of a given manufacturer's product and compare it with products from other manufacturers, as well detecting defects and weak points that were not identified by the manufacturer himself before mass production and sales, thereby contributing to better development and improvement with less risk. In particular, official testing agencies are very helpful not only in evaluating the products of small sized manufacturers, who have very limited facilities and capabilities to adequately test their machinery, but also in promoting the development and improvement of their products. The support provided to those manufacturers ultimately results in the development of machinery of superior quality, and that brings about indirect benefits to farmers.

### *1.4 Facilitating trade both domestically and abroad*

From the standpoint of manufacturers and dealers, passing impartial and neutral testing means obtaining an authoritative official certificate regarding safety and performance. This is advantageous not only for marketing purposes, but also contributes to suppressing exaggerated advertising and unfair competition. Moreover, international testing is useful for eliminating technical barriers between different countries and facilitating trade of agricultural machinery on the international marketplace.

### *1.5 Securing labour safety and hygiene*

In connection with the prevention of accidents and health problems associated with agricultural machinery, it can be said that official testing related to the safety and hygiene aspects of agricultural machinery

greatly contributes to the development and diffusion of safe machinery.

### *1.6 Promoting environmental conservation and energy saving*

Official testing is becoming ever more important on a global scale for the purposes of suppressing the exhaust gases produced by agricultural machinery, alleviating the influence exerted by pesticides and fertilisers on the environment, promoting energy conservation, and preserving the environment.

In **Table 1** are summarized the objectives of the official testing in Japan.

## 2. Tests being performed by IAM-BRAIN

### *2.1 Types*

Currently, IAM-BRAIN is conducting the following types of tests (**Table 2**):

- national test;
- group 1 test of IAM test;
- group 2 test of IAM test;
- safety test;
- OECD test.

### *2.2 Generalities*

All the test mentioned above are non-compulsory. They are carried out on request, and anyone may apply for the testing. Generally speaking, however, the application is submitted by the manufacturer or, in the case of an imported product, by its dealer. Applications are accepted at any time, except for field tests and those subject to restrictions imposed by the crop and the season. The actual costs are borne by the applicant. In this case, "actual costs" means the total of all the expenses incurred to carry out the test, and includes honoraria, payroll, travel expenses, expendables, transportation expenses, etc.

A machine entered for testing must represent the production model, excluding the prototypes and components/parts of Group 2 tests. Therefore, the test is carried out on a single unit which represents the entire series of the same machine, and the test results and model approval are valid for all machines that are identical to the model tested. The test results are made public by the Ministry of Agriculture, forestry and Fisheries, with the exception of the "confidential" group 2 tests.

### *2.3 National Test*

*Objective* - The National test not only has the purpose of suppressing sales of poor quality products through the adoption of an approval/rejection system, but also promotes the objectives set out below by clarifying the performance and characteristics of machines through the execution of the test:

- to provide farmers with information related to the appropriate selection and purchasing of machinery, as well as to its safe and efficient use;
- to assist manufacturers in the improvement and development of machinery.

*Types of machines covered by the test* - The Ministry of Agriculture, Forestry and Fisheries determines which types of machinery are to be tested in each fiscal year, and this information is published in the Official Government Gazette. The status of agricultural mechanisation, the importance of each machine type and its degree of diffusion are taken into consideration when determining the types of machinery (**Table 3**).

*Test procedures* - The tests are carried out in conformity with test codes defined for each type of machine by the Ministry of Agriculture, Forestry and Fisheries, and the tests comprehensively evaluate the performance, construction, durability, ease of handling, safety and other relevant aspects, through laboratory and/or field tests.

**Tractors** - Some of the testing procedures of the National test for tractors are common with those of the OECD test. Therefore, certain test items can be

omitted if the tractor has already been tested with the OECD test code, and the test results of the OECD test can be substituted for those of the National test. This reduces the burden on the applicant and facilitates the trade of agricultural machinery. However, the National and OECD test codes are not perfectly in accord, and the National test includes certain unique test items which are not regulated by the OECD test (**Table 4**).

At present, certain durability tests are not included in the National test because the performance of engines and transmission systems has been previously established, and in this way the time spent on testing is reduced. Likewise, drawbar performance tests with additional weight are not included in the National test because the measurement without additional ballast can provide a rough prediction of performance with additional ballast.

The waterproofing test is one of the tests that is unique to Japan. Because tractors in Japan are normally used in paddy fields, the countermeasure preventing water from entering a machine is an important tractor performance parameter. In this test, the tractor is operated for two hours on the bench, inside a water bin with soil, after which the tractor axle group is disassembled and inspected to determine the amount of water penetration.

A durability test on continuous operation of the power lift is carried out, in consideration of the high frequency of use of the power lift device due to the narrow fields in Japan.

**Combine harvesters** - Field tests of the machine for crops, transplanters, harvesters, etc, are considered to be more important than indoor bench tests. For combine harvesters, two types of field tests which ascertain working accuracy and working efficiency are essential in the National test (**Table 5**). The working accuracy test determines grain losses during the harvesting operation and the working efficiency test measures the time taken to harvest a crop in a regulated area. Grain losses consist of “head loss”, the grain left on the ground during harvesting, “threshing loss”, the grain exhausted with stalk after threshing and “sorting loss”, the grain exhausted with chaff after sorting. In the case of testing on paddies or wheat, if the total grain loss is more than 3 % of the total harvested grain, the machine is rejected by the National test. In the case of testing on soybean, the numerical criteria of grain loss is not regulated because grain loss is easily influenced by conditions of moisture content, etc.

In working accuracy tests the quality of the harvested grain is also checked. If 1% of material other than grain or 1% of mechanically damaged grain is included in the total harvested grain, then the tested machine is rejected.

In Japan, the fields of individual farmers are relatively small, so in combine harvesters they look not only at the question of “speedy harvesting”, but also at the question of “harvesting without grain damage or grain loss”. At every farming exhibition, the manufacturers of combine harvesters give demonstrations which focus strongly on these issues.

**Other machines** - The other kinds of machines, rice transplanters, vegetable transplanters, power sprayers, air blast sprayers, potato harvesters and beet harvesters, are also tested under the National test code. The machines whose test codes include field tests are tested for working accuracy and working efficiency as in the test code for combine harvesters.

**Test result** - On the basis of the test results, IAM-BRAIN decides the approval/rejection of the machine in question. In the case of approval, the Pass Mark Certificate and the test result report are sent to the applicant. In the case of rejection only the test report is sent to the applicant. Notification of the fact is given to the Ministry of Agriculture, Forestry

and Fisheries. In response to this notification, the Ministry of Agriculture, Forestry and Fisheries publishes the name, approval number and test report of the machine in question in the Government's Official Daily Gazette, and notifies the parties concerned in each Prefecture of Japan and all the institutions concerned (**Table 6**).

The applicant can affix the Pass Mark to the approved machine and must supply a copy of the test report when the machine is sold. The test report contains not only the specifications and test results of the machine, but also a photograph of the machine and an explanation of the technical terms and the result data. The photograph makes it easy to physically identify the machine and the explanations makes it easy to interpret the test results.

### *2.4 Safety test*

*Objective* - A large majority of the farm accidents are caused by agricultural machinery. Safety testing of agricultural machinery was initiated in 1976 with the aim of reducing such accidents, by focusing mainly on the machine side. More than 6,000 models have passed since then.

*Types of machines covered by the test* - This test is mainly applied to the principal agricultural machines (31 types), consisting of those which are diffused in large numbers and those which involve a high degree of danger. However other machine types can also be tested if an applicant wishes to do so. Therefore, practically every type of agricultural machine is covered by this test.

*Test procedures* - The safety tests are conducted based on procedures and standards which determine whether the machine being tested meets the safety requirements. These procedures and standards are exclusively related to safety and ease of handling; work performance testing is not included. Seventeen standard items are included in the test:

- protection from moving parts; distance between guards and the extremities of a machine's moving parts, etc.;
- shield of the p.t.o. shaft; guard of the p.t.o. shaft;
- safety devices; structure and function of the safety device for the starting system, engine shut-down device, emergency device, etc.;
- brakes; service brake and parking brake of a machine;
- driver’s seat and space for operation; structure of the step, adjustment of the seat, etc.;
- devices for operation; position and control of the direction of levers, etc.;
- rops;
- hitches and linkages;
- protection from hot areas; cover of exhaust system, etc.;
- protection from sharp edges; countermeasures against sharp edges of parts;
- protection from scatterings; countermeasures against broken fragments of stones or mechanical parts;
- battery; protection from electrolyte solution, etc.;
- stability; stability of the machine on a slope;
- lighting;
- safety mark;
- ease of handling;
- others, limitation of a hand tractor, etc.

*Test results* - After completing the test procedure, IAM-BRAIN assesses whether the machine conforms to the test standards, notifies the applicants of the test results and reports them to the Ministry of Agriculture, Forestry and Fisheries. The Ministry of Agriculture, Forestry and Fisheries publishes the model name of the approved machine and

its approval number, and notifies this information to the Prefectures of Japan and to the institutions concerned (**Table 7**).

## 3. Transition of structure and performance on tractors

The Official tests have seen changes in the structure and working performance of machines over the years (**Table 8**). Some noteworthy points are detailed below.

### *3.1 Structure*

*Improvements in waterproofing* - About 24% of the tractors rejected by the National test in the 10 years since 1974 failed due to water penetration into the machine. The principal causes were insufficient waterproofing performance of oil seals and damage to the oil seals or O-rings during assembly. Nowadays, the performance of oil seals has been improved and the manufacturing process is fully managed, resulting in a marked reduction of problems with the waterproofing test.

*Improvements in ease of handling* - In the National test, the controllability and visibility of tractors must ascertained in actual operation. Ease of handling, visibility and comfort have all been improved today.

*Foot plate (Driver floor space)* - In older tractor models, the transmission case and its lever were generally located in front of the driver's seat, and the operator had to step across this part when driving. So there was little space around the foot, making it difficult to get on and off. In the early 1980s, tractors were developed which had a flat driver floor space, making it easier to get on and off and improving comfort. Most domestically manufactured tractors now have a flat floor with the shift levers set at the side of the tractor.

*Power shift transmission* - The development of power shift transmissions with hydraulic clutches now enables operators to shift gears without having to operate the main clutch pedal. Moreover, a concentrated shift lever which has the function of a sub and main shift lever has been developed, enabling the operator to shift gear with one lever.

*Improvements in the handling of implements* - A device which keeps implements horizontal when the vehicle tilts, and which keeps implements at an angle had been developed. Moreover, the "quick coupler" device which facilitates the attachment of implements is frequently used by farmers.

*Improvements in manoeuvrability of levers and pedals* - Most tractors are now equipped with power steering devices. Consequently, the force necessary to operate a clutch pedal, a service brake pedal or the shift levers has been reduced.

*Safety equipment* - Most domestically manufactured tractors are equipped with safety guards for moving parts and hot areas, covers on both sides of the engine, around the exhaust pipe, etc.

### *3.2 Working performance*

Working performance has been improved since the start of the National test. Some examples of improved tractor performance are detailed below (**Table 9**).

*Elasticity* - Engine elasticity is an important performance parameter of diesel engines used in agriculture or other industries, which operate under severe load change conditions. It is defined by the following equation, as the ability of the engine not to stall even if the revolutions go down when the load is abruptly increased:

$$\text{Elasticity} = \frac{\text{Max. torque}}{\text{Torque at max. power}} \times \frac{\text{Revol. at max. power}}{\text{Revol. at max. torque}}$$

**Figure 1** shows the changes in the elasticity of Diesel engines mounted on tested tractors. The average figure for 10 years in the 1970s was 1.78, while the average figure for the past

10 years is approximately 2.08.

*Specific fuel consumption* - **Figure 2** shows the changes in specific fuel consumption. Direct injection types and indirect injection types are shown respectively in this graph. The average consumption over the past 10 years is about 6% lower than it was in the 1970s.

*Exhaust smoke* - The changes in the concentration of exhaust smoke from Diesel engines are shown in **Figure 3**. The average smoke number for the 5 years between 1984 and 1988 was approx. 20 for direct injection engines and approx. 13 for indirect engines. However, its concentration has been reduced and the figure is now approx. 9 for direct engines and 6 for indirect engines.

*Noise* - The noise level at the driver's ear is shown in **Figure 4**. This noise level has been reduced owing not only to improvements in the sound insulation and vibro-isolation of cabs, but also to the measure of the engine as a noise source. Thus the noise level of tractors with and without cabs has been reduced in recent years. The changes in the ambient noise level are also shown in **Figure 5**, and this figure too has been reduced in the past 8 years

**Fig. 1** - Diesel engines: changes in elasticity

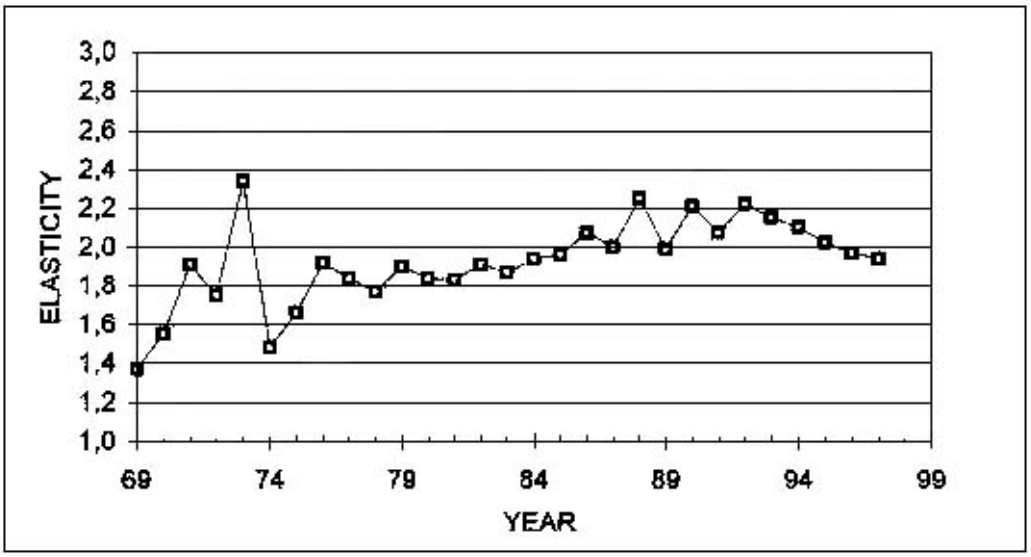

**Fig. 2** - Diesel engines: specific fuel consumption in direct and indirect injection

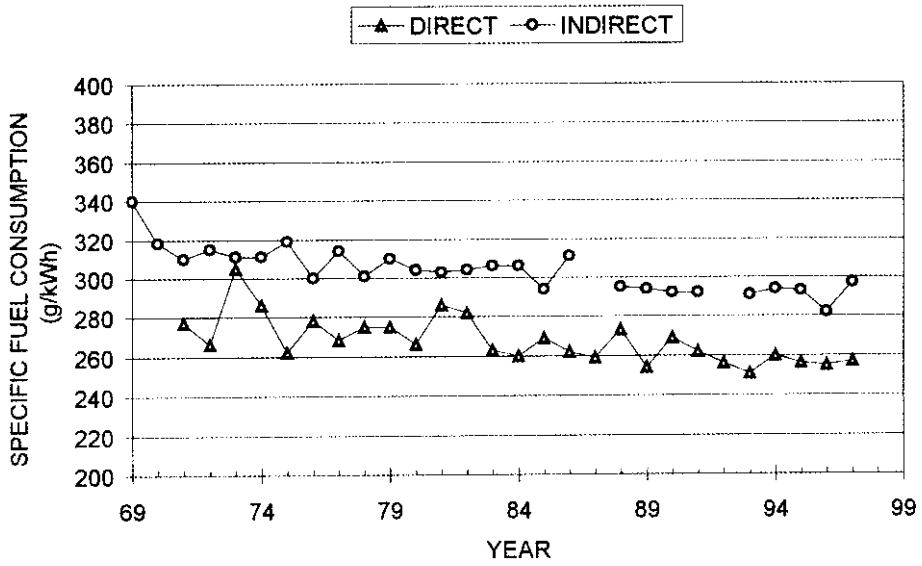


**Fig. 3** - Diesel engines: exhaust smoke concentration

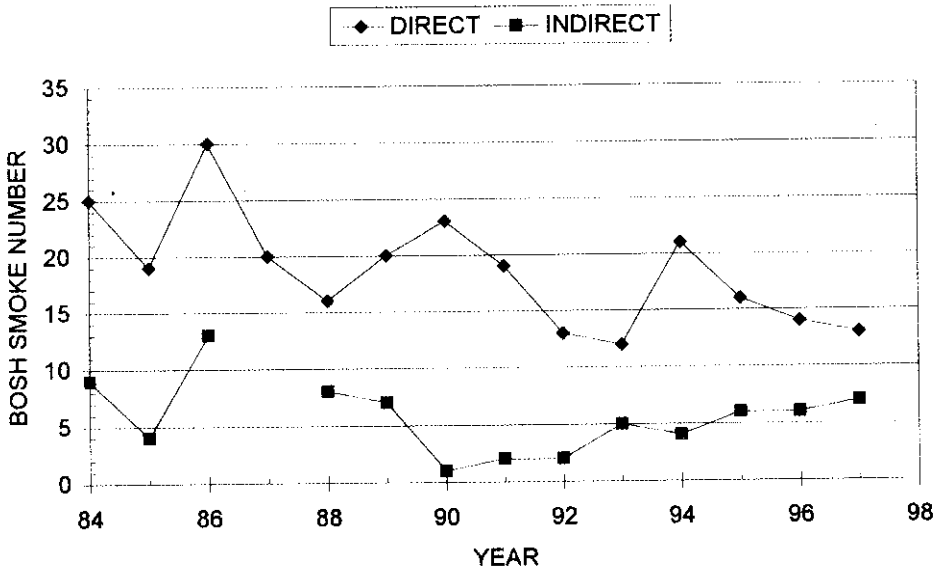

**Fig. 4** - Noise at the driver's ear

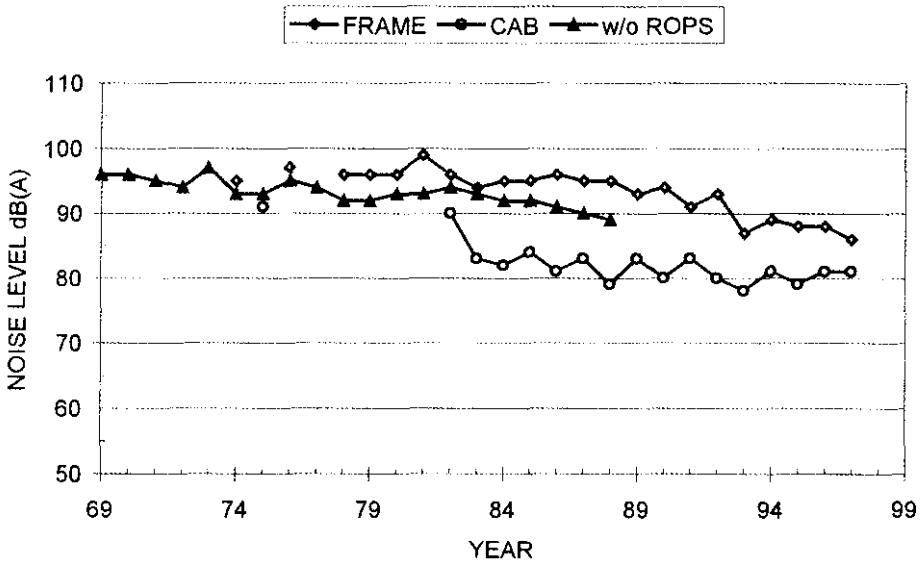


**Fig. 5** - Ambient noise level

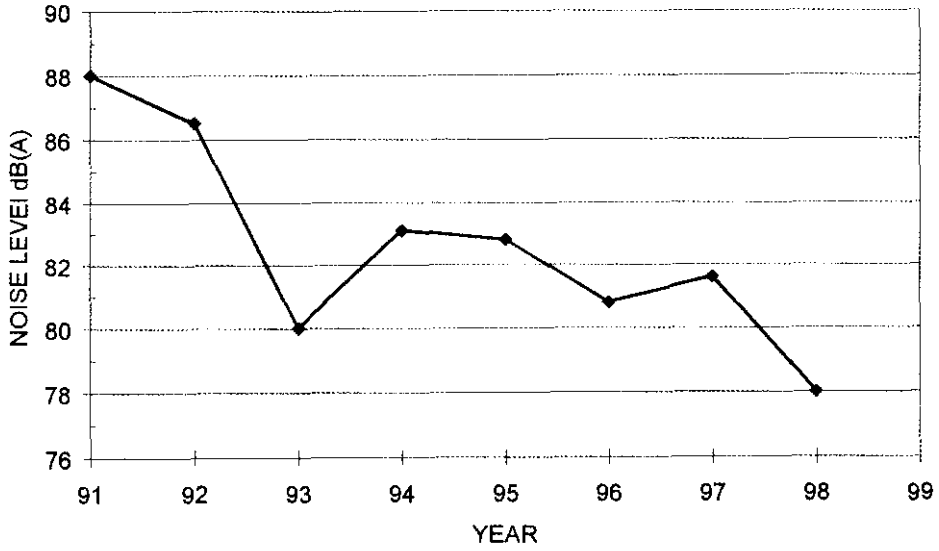


**Table 1** Objectives of the official testing

| |
|---|
| Eliminating poor-quality products |
| Guiding appropriate choice and use |
| Supporting development and improvement |
| Facilitating the trade both domestically and abroad |
| Securing labor safety and hygiene |
| Promoting environment conservation and energy saving |

**Table 2** Kinds of the official tests currently conducted in Japan

| | |
|---|---|
| National tests | 9 types |
| Group 1 of IAM test | 12 types |
| Group 2 of IAM test | Any types of agricultural machines |
| Safety tests | 31 types and more |
| OECD tests | Tractor and ROPS |

**Table 3** Machines on the national tests

| |
|---|
| Tractors |
| Rice transplanters |
| Vegetable transplanters |
| Power sprayers |
| Air blast sprayers |
| Potato harvesters |
| Beet harvesters |
| Combine harvesters |
| ROPS for tractors |

**Table 4** Difference between the national tests and OECD tests

| TEST ITEM | NATIONAL | OECD |
|---|---|---|
| PTO performance<br>**- 2 hour-running** | without | with |
| Drawbar performance<br>**- Test with ballast**<br>**- 10 hour-running** | without<br>without | with<br>with |
| Power lift performance<br>**- 1000 times running**<br>**- Water proof**<br>**- Handling** | with<br>with<br>with | without<br>without<br>without |

**Table 5** Field tests on combine harvesters

| | |
|---|---|
| Working accuracy | To inspect grain losses<br>To inspect damage grains |
| Working efficiency | To measure time to operate |

**Table 6** System of the National tests

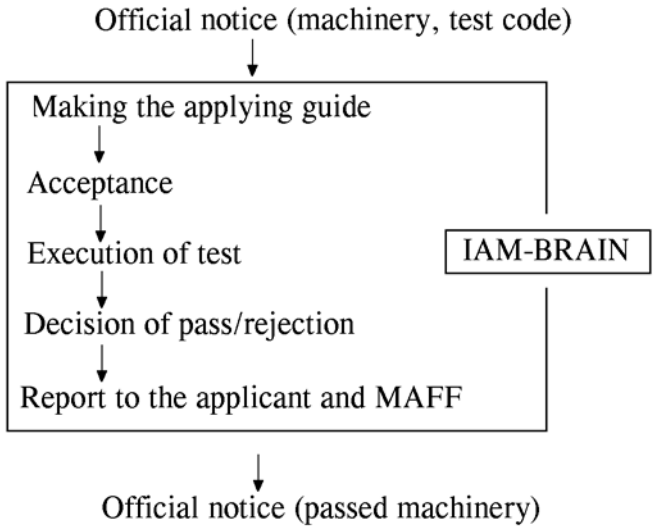


**Table 7** System of the safety tests

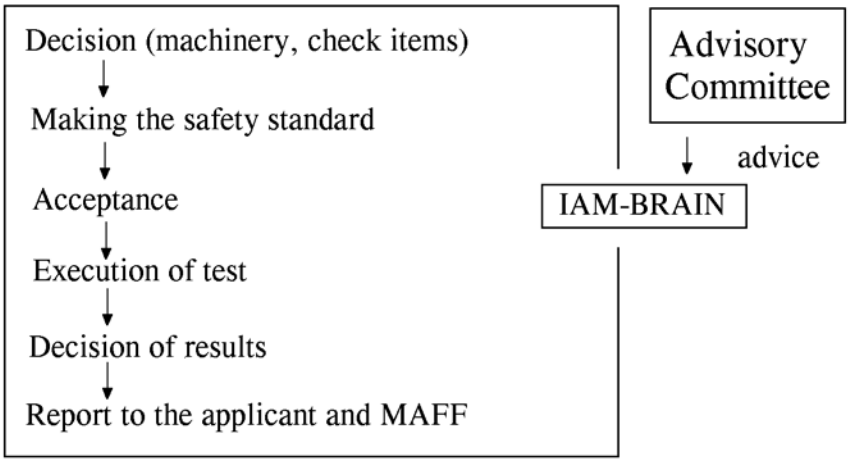


**Table 8** Transition of structure

| |
|---|
| 1. Improvement of water proof |
| 2. Improvement of ease of handling |
| - Foot plate |
| - Power shift transmission |
| - Improvement of handling of implement |
| - Improvement of hardness of operating levers and pedals |
| 3. Safety equipment |

**Table 9** Tests definitions

| | |
|---|---|
| **Torque back up ratio** | Ratio of maximum torque and the torque at maximum |
| **Elasticity** | (ratio of revolution at maximum power and at maximum torque) x (torque back up ratio) |
| **Smoke concentration** | Exhaust smoke density indicated by the figure from zero to 100% |
| **Maximum drawbar pull** | The drawbar pull which is lower value either at wheel slippage of 15% or at maximum drawbar power |
| **Lifting force** | Actual value of lifting force equivalent to 90% of the pressure at relief valve setting |
| **Noise** | Maximum noise level in drawbar working in the speed gear nearest 7.5 km/h of nominal speed |

# On the certification of agricultural machinery

by ***Hans-Hasso Bertram***
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## 1. Why certification: goals for farmers and manufacturers

Appropriate agricultural mechanisation plays a fundamental role in aiming to reduce agricultural production costs, improve the quality of products and protect the environment.

In addition, mechanisation must protect the health and safety of farmers.

All this taking into account that mechanisation is a fundamental requirement within a context of increasing free trade of agricultural products on world markets, especially in the European Union where financial subsidies to farmers are being reduced.

For all these reasons, mechanisation has become a major item in the agricultural farm budget, accounting for approximately 22–25% of total costs, up to a maximum of about 50% on animal husbandry farms.

In view of the above, and considering the highly sophisticated and expensive mechanisation lines available on the marketplace, it is of fundamental importance to provide farmers with an effective tool for the correct choice and purchase of machines and their proper use on the farm.

Certification represents an effective tool for meeting the above requirements, allowing every machine to be credited with the results of performance, materials quality and safety tests, and providing useful information on its best use.

Certification offers obvious advantages to manufacturers, farmers and dealers by guaranteeing that the machine produced, purchased or sold meets all national and international safety and performance standards, providing an official written certification that serves as an "identity card" of the agricultural machine or equipment, to be used by the farmer throughout the machine’s life for different purposes such as second-hand purchase etc.

In Europe, the emanation of the Machinery Directive (EU Directives 89/392, 91/368, 93/44, 93/68) represented a new important step towards harmonised international standards, reducing the role of the various national standards in order to facilitate free trade within the European Union, even though some countries continue to adopt national standards.

There is no doubt that, in the future, harmonised standards will define the minimum requirements for a product to be sold within the common market, alongside the existing national standards.

These minimum requirements principally address compulsory safety features, but may also concern performance and quality in terms of durability, materials and assembly of components.

For most agricultural machinery to meet these standards, the manufacturer must follow a compulsory procedure in order to demonstrate that the machine is safe.

The introduction of many specific harmonised standards has rendered testing procedures more difficult and expensive, because a greater number of tests have to be carried out, requiring more specific instruments and skilled technicians.

In addition, almost every European country has its own testing facilities and its own official mark.

Within this context, manufacturers have to meet a number of specific standards, and the additional cost of a simple voluntary certification doesn't always repay all investments, especially for smaller manufacturers who do not have the resources to send a machine to every testing station and

meet all the national standards still in force.

Thus, for the manufacturer voluntary certification becomes something “extra” that gives the product added value but does not necessarily increase sales.

Testing stations, on their part, face increasing costs in order to satisfy all the different tests required.

On the basis of the above considerations, it was necessary to promote some kind of co-operation among the testing stations of various countries (particularly in Europe) in order to stimulate synergies aimed at optimising certification activities and reducing expenses.

Furthermore, the introduction of harmonised standards represented a unique opportunity to initiate co-operation among European testing stations.

## 2. Certification of agricultural machinery: the Italian experience

The certification of agricultural machinery and equipment was introduced many years ago in various countries; in Germany for example it started about 100 years ago, in Austria few years ago, and specialised Institutions were set up for this purpose.

In Italy, a first attempt was made in the seventies by UMA (Agricultural Machinery Users). Then, in 1987, the Ministry of Agriculture established CONAMA to serve as a meeting point between manufacturers and users, with the main aim of starting a certification service for agricultural machinery.

The first steps were quite difficult because the testing methodologies had to be prepared, to which end CONAMA promoted working groups composed of experts from universities, research stations, manufacturers and other technicians with proven experience in the field.

These working groups prepared the first methodologies dealing with crop protection, soil tillage and harvesting machinery. In 1998 the following methodologies were approved by the National Committee for Agricultural Mechanisation of the Italian Ministry of Agricultural Policies:

- crop protection;
- soil tillage;
- seeding;
- combined operations of soil tillage and seeding;
- irrigation;
- unifeed preparation;
- drying;
- fertiliser spreading;
- slurry spreading;
- tyres;
- chopping;
- mowing - and mowing conditioning;
- baling;
- milling;
- winching;
- motor sowing;
- log splitting cones;
- drive shafts;
- components and hydraulic systems;
- crop protection components: nozzles and anti-drip devices.

These methodologies include detailed information on test conditions, procedures for carrying out tests and for drafting test reports containing the main results.

They are based on international standards and are printed on test reports approved by the main Italian Farmers Associations (CIA, Coldiretti and Confagricoltura), by the Farm Contractors Union (UNIMA), by the Manufacturers Union (UNACOMA) as well as by the Permanent Commission of Agricultural Mechanisation of the Ministry of Agricultural Policies.

The second step was to set up specialised testing stations for the different kinds of machinery inside the already existing research stations.

CONAMA then promoted meetings with manufacturers in order to inform them about this new service. Initially, many viewed it as an obstacle to free national and international markets, deeming the CE mark sufficient for selling machines, and CONAMA had to explain that an official test could give significant added value to their product, and that farmers were beginning to request it.

After overcoming the initial difficulties, CONAMA has tested and certified many machines for crop protection and soil tillage on the Italian market, providing the manufacturers with an official report detailing the real performance and certifying conformance to all the safety requirements.

This has given manufacturers an opportunity to start co-operating with the testing stations in order to check their products and continuously improve their quality.

As of September 1998 CONAMA had tested over 200 machines, 170 of which obtained certification; more will be certified as soon as testing activities on other typologies is started.

### 3. Certification of agricultural machinery: the German experience

In addition to Dr. Liberatori's report about the Italian experience with testing agricultural machinery, there follow some remarks about conditions in Germany. Since its foundation in 1885 by the engineer and writer Max Eyth, the German Agricultural Society (DLG) has seen itself as a promoter of progress in the agricultural and food sector. Right from the outset, the testing and approval of agricultural machinery were the main fields of activity undertaken by the DLG to promote progress. Looking back on over a hundred years of testing agricultural machines and implements, the DLG has continually striven to set new standards.

When it comes to the objective assessment of the utility value and the safety of agricultural machines, implements and equipment as well as tractors, the DLG is the competent, impartial and economically independent testing authority. Today, the two test centres in Gross-Umstadt and Potsdam-Bornim belong to the world's leading testing institutions for agricultural technology.

As Dr. Liberatori mentioned already, farmers and private contractors need reliable information in order to plan and make investments in machinery or equipment. They must know before they buy which machine is appropriate for their particular circumstances - for instance in terms of size, type of soil, topography, climate zone, existing machine fleet, which fulfils the required functions best and which stands up to the tough conditions prevailing in practice. After all, there is nothing as expensive as the wrong investment.

In our stations, tests are not restricted to design characteristics. Particular attention is paid to practical performance - what functions are performed under practical conditions and in what way? What are the farm sizes and tasks for which a machine is particularly suitable? Are traffic and working safety guaranteed, are aspects of environmental and animal protection taken into account?

Having successfully undergone testing, the machine is awarded a "DLG-approved" test plate. The detailed results are published in DLG test reports and in trade publications. This gives potential users the necessary information on which they can base investment decisions.

The advantages are twofold. Firstly, manufacturers receive an authoritative test result compiled by unbiased experts. This leads either to "DLG approval", in which case the results are published with the consent of the manufacturer, or the findings may point out flaws in the product which the manufacturer can then rectify either during or after the testing procedure, thereby ironing out problems before the machine goes into series production. This is an excellent way of

avoiding subsequent complaints from customers and expensive corrections which have to be carried out during the guarantee period. DLG approval of operational and traffic safety are important aspects in connection with product liability, and they protect manufacturers from unjustified claims for damages.

Secondly, industry profits from the advertising power of DLG approval, which is recognised by farmers to be an assurance of quality.

For decades, DLG tests have received extensive financial support from the Federal Ministry of Food, Agriculture and Forestry (BML). This is only logical, because effective and safe agricultural machines mean savings in macro-economic costs in many other areas.

What are the advantages of international co-operation? The main aspects have already been pointed out by Dr. Liberatori: with the increasing internationalisation of the production and marketing of tractors and agricultural machinery, it becomes a problem if a machine has to be tested in each of the countries where it is sold. Common testing activities enable both manufacturers and testing stations to save on investments. More test reports for the farmers are another very important point to be taken in consideration. We are sure that, in the future, manufacturers will prefer tests which are valid in more than one ore two countries. We therefore joined the Agreement between CONAMA and BLT after a very brief discussion time.

A great advantage of this agreement is, in our opinion, that the text fills no more than 1.5 pages.

The main objectives are (art. 4):

- to support the mutual Agreement;
- to co-ordinate the technical upgrade of tests;
- to promote the exchange of information among Institutions in order to reach a common testing methodology and a common model of printed report for every kind of agricultural and forestry machinery and equipment;
- to verify the proper conduction of tests;
- to study the possibility of initiating common research programs for improved technical standards and tests;
- to maintain contacts with other National and European Institutions.

Most of the activities towards reaching this agreement were carried out by CONAMA. So on behalf of all the members I would like to conclude this report by saying many thanks to CONAMA, and especially to the President and initiator Prof. Dr. Pellizzi, and to the general manager Dr. Liberatori, who have worked extremely hard to reach the point where we are today in what I believe is a very short time.

**4. Common activity: the Agreement, why?**

In 1996, during the EIMA Fair, CONAMA invited representatives from the main European testing stations to present their certification activities, with the objective of promoting common operations among all the participants.

Then, in May 1997 in Rome, the testing stations of Austria (BLT - Bundesanstalt für Landtechnik), Germany (DLG - Deutsche Landwirtschafts-Gesellschaft e. V.) and Italy signed an Agreement for the mutual recognition of testing activities on agricultural machinery.

This was the first step towards a European Agreement between testing stations.

In 1997 and 1998 there followed other important meetings: in Germany, in Austria where the Institute of Switzerland (FAT – Eidgenössiche Forschunganstalt für Agrarwirtschaft und Lantechnik) joined the Agreement, and last September in Italy where all participants were shown the testing facilities and experiences made to date.

At this last-mentioned meeting the DIAS (Denmark) and CEMAGREF (France) also

joined the Agreement.

A strong base was thus set up for important co-operation, and in the future we hope that all the major European testing stations, and perhaps also those of countries outside Europe, will join the Agreement

The aims of the Agreement are to improve the certification of agricultural machinery through the following steps:

- mutual recognition of testing procedures;
- creation of a network of skilled laboratories;
- development of common activities.

In order to obtain the following advantages:

- reduce the costs of testing procedures and other common activities;
- optimise investments in testing implements;
- offer the manufacturer the possibility of obtaining full international certification with a single test;
- give the farmers an effective support for the choice of machinery and equipment and an assurance of using machines designed to be perfectly suitable to their needs.

The mutual recognition of testing procedures is a very important step because it allows manufacturers to obtain greater benefits from a single test that is recognised by all the other testing stations; therefore, with only one full test the manufacturer obtains the marks of all the testing stations participating in the Agreement, and is able to export his product to all those countries.

The network of well-established laboratories provides an opportunity to expand testing facilities, avoiding overlapping equipment and optimising investments.

The Agreement is very important for this purpose, giving every testing station the opportunity to specialise on certain types of machinery, and disseminating the outgoing information to all the other stations, thereby optimising the activities.

Other important activities will be developed together, based on wider experiences and skills and the sharing of investments.

All these points require close co-operation which will be developed in the coming years, providing the entire sector with strong support and helping to prepare it for the future global marketplace.

The Agreement becomes even more important if we consider that, with regard to safety, for most agricultural machines and equipment the Machinery Directive provides for a CE mark based on manufacturer self-certification.

In the course of our testing activities it has not been uncommon to find machines already on the market which do not conform to the required safety standards, even though they carry the aforesaid CE mark.

Furthermore, the CE mark only defines a minimum safety requirement, and does not say anything about performance, quality etc.

It is therefore difficult to envisage a market without specialised testing stations that can provide farmers with all the additional information that is of such importance considering the high cost of machines and equipment, and manufacturers with an official certification of their products.

A good example can be drawn from the automotive sector, where we find many magazines which carry out all sorts of tests which are highly considered by the drivers.

Similarly, the agricultural sector needs this type of activity too.

## 5. Problems to be solved

Of course there have been and there will be many problems to be solved, mostly due to differences in the testing methodologies, costs of tests and the different environments in which the machines are tested and will be used by the farmers.

One example of this are the difficulties which we encountered when comparing the

methodologies for soil tillage machinery; although these were mostly based on the same international standards there were certain differences.

In fact, DLG carried out duration tests and CONAMA did not, while CONAMA was more demanding on safety requirements.

Now CONAMA is starting to include duration test and DLG is studying the possibility of including further safety requirements.

The end result will be a common methodology and full recognition of the certification, but in so far as there are differences the Agreement provides a recognition only of the test results.

This example gives an idea of the potential offered by the Agreement for improving each activity, moving towards common testing procedures and common results.

## 6. Conclusions

We hope that to provided a comprehensive report on the reasons for certification, its activities, the problems to be solved and the final goals of the Agreement.

At present, not all European testing stations have signed the Agreement, but we hope that in the future they will understand its importance and advantages in a market characterised by harmonised standards, free trade and a common currency.

Such an Agreement provides an opportunity to improve testing activities, research and expansion by assigning business-oriented activities to the testing stations- a very important aspect in a climate of diminishing public funds.

The Agreement was initiated within the European Union, but in the future it will be very important to extend this activity to countries outside the EU, in order to facilitate international markets.

We can envisage an international network of testing stations for agricultural machinery, similar to OECD for tractors, with common standards, common studies to improve testing activities and to support ISO and EN working groups, and a common database with all the results !

This would be a fantastic tool for improving every kind of research in these fields, and to prevent overlapping investments and redundant activities.

We think that, with this final message, we can open the discussion, which we hope will be a precursor to future extension of the Agreement to as many countries as possible, thereby providing a real service to all farmers.

## DISCUSSION

**Lothar FISCHER**

*I have two questions for Mr. Takahashi. The first one is: am I correct in understanding that one of your duties is to guard against unfair acts of competition? I believe you mentioned unfair competition. And my second question is: when we look at the development of noise level, fuel consumption, smoke emissions and so on, are the results you show only from Japanese tractors, or also from imported tractors?*

**Hiroyuki TAKAHASHI**

*In answer to the first question: each manufacturer presents the figures for his tractors, and these figures are then used in trade with manufacturers and farmers. In some cases, manufacturers may present a kind of unfair specification of the machines, so it is useful to make public specifications by independent institutes. This will contribute to fair competition among manufacturers.*

*As regards the improvement of noise or fuel conditions, these figures include the tractors imported into Japan. At this moment we don't know the details of how many tractors are included.*

**Giuseppe PELLIZZI**

*If it is possible I should like to have a copy of your transparencies, Mr. Takahjashi, so that we can include them in our proceedings. And now a question: how many agricultural machines do you test and certify in Japan, per year?*

**Hiroyuki TAKAHASHI**

*Regarding the duplication of the transparencies, of course we will provide you with photocopies for the proceedings. In answer to the second question, regarding the number of machines that we are testing: at this moment we don't know the exact number, but I am testing tractors, so the number of tractors we are testing each year is 20 or 30 tractors a year.*

**Karl RENIUS**

*I have a question regarding the specific fuel consumption of Japanes tests. The values are very high compared to other tractors. Is the reason that you have very high speeds, and you measure these values at rated engine speed? And that you have very small engines? Are these two reasons responsible for these very high values?*

**Hiroyuki TAKAHASHI**

*The power of tractors we tested is from 15 kW to 75 kW. The condition for the fuel test is with the p.t.o. drive at maximum power, so this is the reason for the high values of fuel consumption.*

**Arturo LARA LOPEZ**
**Mexico**

*My question to Mr. Takahashi is: do you have the same procedures, or equivalent procedures to those used by other testing labs in the world, such as those in the U.S., the U.K., Nebraska and the like? And can you compare your results with those of other machinery testing laboratories?*

**Hiroyuki TAKAHASHI**

*For the tractors, we have OECD tests, so we have discussions with other institutes regarding test codes and the like. But in the case of other machinery, for example combine harvesters etc., we do not exchange data.*

**Francis SEVILA**

*BRAIN is a famous and efficient research laboratory for farm machinery, and we have heard an interesting presentations about the testing activities of this institute. Could you tell us how you interact with the research activity in*

*your institute - or how you do not interact - and how this is handled by the institute. Do you have relations with research activity in your institute or not?*

**Hiroyuki TAKAHASHI**

*We have two different Departments, the Department of testing and evaluation and the Department of research and development. We exchange information with these departments to facilitate our test and research activities.*

*Regarding the national test of tractors, from 1969 to 1997, 1040 tractors have passed the test.*

*Regarding the exchange of information with other test institutes, the reason we do not exchange information about non-tractor machinery such as combine harvesters is that we have different types of machinery: for example we have head-feeding combine harvesters, while other countries have rear-feeding combines. That is why we can't have discussions or exchange information about these machines with other test organisations.*

**Bernard CHEZE**

*I very much appreciate the job done by the European network, and the way it has been built - I think it's very positive, and its a good prospect for the future. Just one question. You said that you need to establish standards of course, particularly on the safety aspect. I would like to ask: in what way can the different members of your network put some pressure on their standardisation bodies, in order to make them deliver the standards that are really needed - those which are key standards - for safety conformity? In particular I would like to stress the fact that there is the well-known PR EN 1553, which is a common requirement for common parts of agricultural machinery. This is really a key standard, and it's a pity to see that for so many years this standard hasn't come out. So you are using the PR EN, but certainly you would be more at ease towards the manufacturers if you had real EN 1553. So I would say to the different members of your network, that really you have to do something both towards these standardisation bodies, in your own member countries, and also towards the association of manufacturers. And one last comment - you said that you prepared guides for conformity. I think it's an excellent job. I've seen the two guides you've made, one for fertiliser spreaders and another one for soil tillage. I think this is a very good idea and I hope you will go on developing this sort of practical guide to help manufacturers.*

**Hans Dieter KUTZBACH**

*Nowadays machine tests are also performed by agricultural journals. These tests are very fast, they are for the consumers, and they reach a lot of the readers of these journals and the farmers. So how do you handle this aspect? Is this a severe competition for our institutional tests?*

**Francis SEVILA**

*I would like to ask the two speakers about the cost of these testing approaches. We all know that these are expensive services. A lot of people are needed to operate expensive equipment, instrumentation and so on. If I remember correctly, because I once used to work for such an institute, the cost is not totally paid by the industry who is asking for the tests. And also, if I remember correctly, the situation is not the same in every country, concerning how much the public money is contributed or not. So the first question is: what is the situation in Japan? Who is paying for the tests? And my second question - I don't put the same question for Europe because it would take too much time - but in this agreement that you have been showing us, what is your strategy to ensure fair competition between testing stations? I believe that these European testing stations range from no cost for the test to full cost for the test. And I'm afraid that this is not a sustainable situation.*

**Derek H. SUTTON**

*Three hopefully short questions. The first one is a factual one. I'd be most interested to know what proportion of tests result in a rejection or a failure; in other words you don't award the certificate or whatever. And in those cases, can they resubmit with a redesigned model of the same machine within a certain time? What is the procedure on that score? The second question concerns the difficulties of standardising test procedures. I'm remembering the early days of OECD, it was a terrific business to get agreement on the standard test procedures for tractors. And in their attempts to reach agreement on combine test procedures, I don't think they ever reached a common agreement - an agreed procedure. And I particularly would be interested in the case of soil tillage equipment, where if you carry out a test of a soil working implement in sandy soils in Denmark, and get approval for it, and then work it in very heavy soils in southern Italy or something... there may be a very different situation for durability. And I'd be interested to know how much progress is being made on reaching agreement on those procedures. The last question is - really what is the reaction generally of manufacturers to your excellent co-ordination proposals?*

**Hiroyuki TAKAHASHI**

*As I said, BRAIN has two separate Departments: a department of research and development, and a Department of inspection and testing. So for the costs of the Department of research and development, 100% of the money comes from government. For the testing activities, over 90% of the cost will come from government, while around 10% of the costs of the testing activity are paid for by the industry.*

**Hans-Hasso BERTRAM**

*I will first answer Mr. Chèze from France. Of course there are standards, there are projects for standards, and there are no standards. The first thing I'd like to say is that it's not our intention to create a third committee alongside EN and ISO. This is very important. Of course when there is not an international EN or ISO standard, we adopt national standards. In the case where there is not even a national standard, we try to see how to adapt our experiences in order to come to a solution. And all these experiences we then use to make proposals for the standards. Because of course we have a long experience on testing machines, problems on machines, so we can make proposals. Thus when there is no standard we define a solution and then we make a proposal for a standard.*

*In answer to Prof. Kutzbach's question about the machinery tests done by agricultural journals: first, we don't conduct performance tests on tractors, because manufacturers are not willing to give us the tractors for more than a year for testing, or for more than 100,000 hours. So we stopped doing these performance tests with tractors some years ago, and instead we do some test work which approximates performance testing with special rules and so on. All the questions concerning performance of tractors are answered by a special group of consultants, which includes some of our specialists. As regards the other machines, it isn't possible for us to cover all the groups of machines which are of interest to the farmers in the year, so we do not have reports for all these machines. However they are sometimes covered in agricultural journals with short reports. Our aim is to cover more and more types of machines, and for this reason we have joined this agreement: to get more information from other countries in order to cover more groups of machines.*

**Sandro LIBERATORI**
**Italy**

*In answer to the question about the prices and costs of tests. Of course this matter has been discussed among the testing stations taking part in our agreement. There are different prices for the tests: in some countries almost the full price is covered by the government, in other countries the full price is covered by the manufacturer. The important solution we found is that we must*

*arrive at a common price in order to avoid competition among testing stations. There must be no competition. We must all give a service, at one price, so the manufacturer will be able to choose where he wants to go to test his machine. And in the future we must keep in mind that all these activities must become more business oriented, because in many countries government subsidies for testing stations are being reduced, and will be reduced more in the future. So we must change our activity to provide an enhanced service to the manufacturer, not just a technical service but also something approaching a commercial service. And I think that offering a single test with a certification that is valid in several countries goes in this direction. It's very important for the manufacturer, because we give a technical service and a commercial service to the manufacturer. Although this activity was initiated only a short time ago, we have already had very very positive results on this, with more and more manufacturers coming to test their machines. I think this is a very important result.*

**Hans-Hasso BERTRAM**

*Currently we get 70 to 80% of our money from the government, but as you know our government changed some weeks ago, and we don't know what will happen in the future. So all the other points are the same as Dr. Liberatori told you already. The manufacturer has to pay nearly 20-25% of the real cost of the test at the moment, and we get the rest of the money from the government. That's in answer to the financial question. And now to answer the question from the UK: about 20% of the machines don't get a positive results - a positive report. In these cases the machine can sent back to the manufacturer, he changes some details and submits it again. He does not have to pay the full price of the test and then start again. And normally he gets a positive result in the end. But of all the machines which come in for testing, only 20% leave our test station exactly as they arrived, so most of them are changed in details.*

*The other question was about combine harvesters, the test codes for combine harvesters. In Germany we have an industrial group like UNACOMA which is discussing test codes for combine harvesters at the moment. We will change them or modify them, and we are working in close connection with CEMAGREF in France on this job. The third part of your question was about different testing conditions, especially for soil preparation and so on. We have the same differences in our country, you know. We have light soils, and we have heavy soils. Our proposal is that the test conditions should be defined more clearly than they have been up to now. So we have to cover most of the conditions in our country, although not those which are very special in some details. It's the same I think for our partners. But we have to describe the testing conditions as precisely as possible, so that you can compare whether they are similar to those in your country or not. We have the same problem with mineral spreaders. There are different types of minerals, in terms of calibration and so on, and we have to define this as exactly as possible, so that you can compare it with your conditions and see if these test results are applicable to conditions in your country or not.*

*Finally, as regards the reaction from the industry, I would say it has been positive up to now.*

**Pavel KIC**
**Czech Republic**

*I would like to give you some information about the situation in the field of legislation of testing systems in the Czech Republic. Maybe this is one example of a situation in the field of transformed countries, which are asking to be members of the European community in the future. Generally I can say that testing of agricultural machinery is one of our traditional activities in the field of agricultural engineering and I should like to show you these transparencies which summarize the structure and the activities carried out in the Government Testing Laboratory of Czech Repubblic.*

## Government Testing Laboratory of Agricultural, Food Industry and Forestry Machines

**Statute**

- Third party testing laboratory established by Ministry of Agricultural
- Authorized Body - AO 206
- Accredited Testing Laboratory No. 1054

**Staff and support**

| | |
|---|---|
| Management | 34 |
| Laboratories PRAGUE | 43 |
| Laboratories BRNO | 58 |
| Total | 135 |

### Types of activity

- Testing
- Certification
- Conformity assessment
- Standardization
- Consulting
- Supervision, inspection

### Competence for measurement, testing and assessment

- Safety – general
- Safety - transport
- Mechanical properties
- Ergonomic
- Acoustics, vibration
- Electrical properties
- EMC- electromagnetic compatibility

### Sphere of tested products

- Tractors
- Agricultural machinery
- Earth - moving machines
- Road building machines
- Public utilities technology
- Protective structures
- Machinery
- Food industry
- Packaging machinery
- Small mechanization (garden, forest)
- Wood technology

### Activities relating with OECD Codes for tractors

**Code 1** for the official testing of agricultural and forestry tractor performance
**Code 2** for the official testing of agricultural and forestry tractor performance – restricted
**Code 3** for the official testing of protective structures on agricultural and forestry tractors(dynamic test)
**Code 4** for the official testing of protective structures on agricultural and forestry tractors (static test)
**Code 5** for the official measurement of noice at the driving position(s) on agricultural and forestry tractors
**Code 6** for the official testing of front mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors
**Code 7** for the official testing of rear-mounted roll-over protective structures on narrow-track wheeled agricultural and forestry tractors
**Code 8** for the official testing of protective structures on agricultural and forestry track-laying tractors

**Activities relating with ECE Regulations (vehicles)**

- E/ECE/324 Agreement
- ECE Regulation No. 71 Agricultural tractors - driver's field of vision
- ECE Regulation No. 86 Agricultural tractors - lighting and light-signalling devices

**Activities relating with EEC Directives**

- 73/23/EEC Low voltage
- 89/336/EEC EMC
- 89/392/EEC Machinery
- 74/150/EEC Agricultural and forestry tractors

**Activities relating with EUROTEST Association**

- Testing of building and earth-moving machinery
- Cooperation with testing laboratories and notified bodies of EU and CEFTA countries (United Kingdom, Germany, Italy, Sweden, Poland, Slovakia)

**Other services**

- Partake in development and standardization of testing methods in ISO, IEC, CEN, CENELEC and ECD
- Consulting for public bodies, producers, consumers, users and their associations
- Consulting and preparation of producers for implementation quality assurance systems according to EN ISO 9000
- Consulting for producers (exporters) on conformity assessment in EU (CE marking)

**Accreditation, authorization**

- SZZPLS is the accredited testing laboratory No. 1 054. Accreditation according to EN 45 001 was given for testing of agricultural, food industry and forestry machines, earth- moving and building machinery and machines of relative branches
- Accreditation SZZPLS as certification place according to EN 45 01 1 is in preparation for IV. Q. 1998
- Since 1.9.1997, SZZPLS is the authorized body AO 206 in accordance with the Act No.22/1997 Coll.
- SZZPLS is authorized by Ministry of Transportation for national testing in accordance with Act No.38/1995 Coll. and international approval of vehicles category T (tractors ) specified for public communication in harmony with ECE regulations (Geneve) with registered approval mark E8/F
- SZZPLS is the national authority for testing of tractors and their protective structures in compliance with OECD Codes

**Hermann AUERNHAMMER**

*We already have highly sophisticated implements which have electric and electronic components in them. We know that such implements work only in the correct environment together with the tractor and other implements. One of the examples is electric-driven corn planter. So if we test this implement alone the result may not reflect the real situation in a combination. Are there any ideas to have a system test or something like that?*

**Hermann HEEGE**

*You were talking about the methods, and I learnt that at the present time we have not common methods, although the objective is to establish common methods in the future. Do you think there might be a danger that the manufacturers will just look at these methods, and select the country where the testing method suits them best, and have the test done there? Like a student who chooses the professor whose exam he is likely to pass.*

**Johann SCHROTTMAIER**
**Austria**

*I think one great advantage of our agreement, I say this as one of the partners of this agreement, is the political dimension with agenda 2000 in Europe. You know we now have standardisation of safety and so on, and we will get new regulations in environmental standards. And these environmental standards are also part of our testing of these machines. These standards will be very important in future, to get machines for implementing agricultural best practice on our farms. There will also be some money flowing from the European commission to the countries and farmers to work with this best practice agriculture.*

**Hans-Hasso BERTRAM**

*I will first answer the question from Prof. Auernhammer, about the electronic details on the machines. We have already tested one electric-driven precision drill in a performance test, and we agree with Prof. Auernhammer that it is necessary to use some special conditions to test what I would call the "black box" on these machines. Because in the second year of working with this machine we found that some faults had occurred in practice, and the test had already finished. So in our special group for testing conditions we are now discussing special tests for these parts of machines. So in future we will have special tests for these parts of the machine.*

*The second question was from professor Heege: we try to have common rules, and maybe there are some differences in detail, but before testing a group of machines we present these testing conditions to the industry involved, and discuss it with them, and so we hope to have common rules.*

*The next point, which I think is important too, is that before accepting a test report from another country we have the chance to look at the results, and if we don't agree we are not forced to accept these results, we can refuse them. So it's not possible in this case for a manufacturer to use the test results in this country - if we refuse.*

**Theodor FRIEDRICH**

*I have a question regarding the different types of testing standards. We have heard in the beginning that there are tests on performance and work quality which tend to be more in the interests of the manufacturers than the clients. There are other tests or standards regarding safety and environmental features which are in some cases mandatory tests, and I think there is still a sort of difficult situation. For example if we look at sprayers, in Germany sprayer standards are not even dealt with by the DLG, and in Italy I understand that as of next year CONAMA will handle sprayers, from the mandatory side. We heard in the presentation from Japan that BRAIN is a sort of official institution. What does that mean? For example are the tests generally mandatory in Japan, and what sanctions exist for manufacturers who do not submit their equipment to testing at all? Are they excluded from marketing in Japan, or is there no sanction at all, or does it apply only to certain features like safety? What is the situation there?*

**Walter MEIER**
**FAT - Switzerland**

*From the point of view of our country, there is a different understanding and even a different philosophy of testing, and we are very glad that the first step is not to try to unify the test methodology. We know from past experience that a lot of steps in this direction have not been successful. So I would say the basic philosophy is that I know I have good colleagues in Italy, in Germany, in Austria... and I know what the standard of testing is in that country. So before a machine is tested I get the conditions, I get the methodology which they are using - say - in Italy. And it's our decision to join or not. And methodology is not the only reason, but also the fact that in Italy they may be testing machines which are of no interest for Switzerland, for instance tomato-harvesting machines. So I don't join the test.. I think it's really not the time to discuss whether we can unify the latest details of testing methodology. But it's essential that I know the conditions under which they do the tests. And finally we are free in our country to sign or not. I think it's another kind of approach.*

**Jean Marie DEBOIS**
**OECD**

*I've heard the four letters OECD mentioned many times here, and I could probably speak very long but I won't. I would specifically like to talk about the subsidising of testing, just to say that in OECD we have the whole range of situations. My left hand neighbour from Australia will forgive me for saying that in OECD there are 5 countries, including Australia, which benefit from OECD testing but don't participate so don't pay: Australia, New Zealand, Mexico and Hungary - the new member countries. OECD covers all western and central European countries, plus Turkey, Japan, Korea, USA and Canada. I think you all know that the situation in North America is that not only testing but test approval by OECD, and also I must say the OECD secretariat, is paid for by industry 100%. There are other countries - probably mostly in Europe and, as we heard, in Japan also - where the cost is supported by government. This question comes up every now and then in OECD, but this is not part of our agreement I would say, so I need not expand on that. I think basically the philosophy is that either you do testing to protect the farmer or to help to serve the manufacturers. And the former case is more for domestic results of testing, while the other is more for favouring expanding international trade. I think both philosophies are equally valid. But I will finish my comment by calling joint attention to another aspect of testing, which is the benefits that should derive from testing. I have a very concrete and clear example: this Thursday I am going to Geneva, because the WTO committee for technical barriers to trade would like to hear about the kind of standardisation activities carried out by OECD. And OECD has been selected as one of 10 world-wide international standardising bodies. So I will say what I believe the OECD codes bring to manufacturers and to farmers alike. I think that when they see the list of countries belonging to the OECD codes - they will see it is a benefit for countries even if those countries are funded by manufacturers.*

**El Hassan BOURARACH**

*Sometimes we have found some changes in parts and performance of machines from one country to another, particularly in developing countries. So we try to use OECD and other testing reports, but we don't find exactly the same specification. What was done in Europe or in Japan differs from the specification we find in our country. What do you think of this problem and how to solve it?*

**Hiroyuki TAKAHASHI**

*In answer to the question about sanctions and mandatory tests: in Japan we only have the voluntary tests, so we don't have mandatory tests. This means that we have no sanctions regarding this issue. And as regards the standards of test codes, we are an executive organisation, so the definition of a code or a standard is issued by the government.*

**Lothar FISCHER**

*Dr. Liberatori, as a representative of the agricultural machinery industry, I have a slightly different opinion about competition as you expressed it. You didn't want to have competition in terms of pricing. Competition may not be liked, but it's good for the customer. So we need competition, and you should be prepared for it.*

**Sandro LIBERATORI**

*Of course we know that some competition can be good, but I don't think too much competition on testing is good for us. That's because we must keep in mind the final aim of this project, which is to create specialised laboratories in Europe. In every country there will be some laboratories specialised in certain machines. And those laboratories will not be in other countries. One example: mineral spreaders. We had some meetings in Denmark, where there is a very specialised centre for mineral spreaders. They have a very good structure, very good equipment and very skilled technicians. In Italy, then, I am not starting up something like that, because it would be too expensive, and I prefer to send manufacturers to Denmark, because there is already a very good testing station there. I will tests machines in Italy only for small tests that will be valid only for Italy, but for a full European test I will say "go to Denmark". So this is a very good example of what will be the final aim of our activity. In our last meeting we already discussed which typologies of machines every testing station is interested in. It's a start, so we are all improving only specific kinds of machinery, which are different for each testing station. That's because in the future, more than now, we will need very expensive instruments for testing machines, as well as very skilled technicians, and it will be all too expensive for one country to have all this for all types of agricultural machines.*

**Egil BERGE**
**Norway**

*I am following up on the same question. I think Prof. Sevila started a very important discussion about pricing and competition. If you look at cost - there are two main parts to it: there's the variable cost - running cost from the day you start the test till you are finished with the report, and there is the infrastructure cost - the cost of building the testing station, of training the personnel for many years so that they know the specialised test procedures, and maybe of developing new test procedures. And it is impossible for most testing stations to be fully occupied year round, so part of the time they're sitting idle. And who's paying for the idle time? I don't think the customers, the companies requiring tests, are willing to do so. On the other side, I can fully understand that they want some competition, because if you have only one testing station available for a certain test, then in the long run - after twenty years - maybe that testing station won't improve because there is no competition. So you probably need at least a choice of two. But there also probably needs to be an agreement on how to calculate the full cost, I mean full running cost which does not include the infrastructure cost. And if it is allowed that the infrastructure cost is paid by the state, or by whoever wants to do it, then that makes it possible also for the smaller countries to have some testing activity. Otherwise the benefit of volume will lead to all the testing stations being located in the bigger nations.*

**Oleg S. MARCHENKO**

*The problem of certification has recently been raised in Russia. I can say that, in the past, we practically did not buy any foreign machinery - maybe only samples for examination and the like. Now, the situation has much changed, and earlier I showed that our domestic production has gone down very drastically and, if we consider tractors for example, we are now buying more tractors from other countries. But this is all practically without any certification, and we have problems with our tractor fleet. To resolve this we need to establish a new structure for testing. We have machine testing stations, and now we are creating a system of certification; we have set up a scientific centre for testing of agricultural machinery, and we are trying to en-*

*ter into general agreements with foreign companies.*

*Also on the basis of our results, we have produced some recommendations for the ministries, the central government, and the regional governments. Also we would like to have some cooperation with CONAMA, and we would like to use experience of your association. This will be next step. I would like - and I ask - you to help us in this process.*

**Karl Th. RENIUS**

*I would like to make a comment on the competition question which was raised by Mr. Fischer, and I think this is really a strong interest of industry to have a certain pressure on the prices for the tests, but I think in the long term we will have a trend toward reduced subsidies in Europe, and then that competition will come up outside Europe. So that competition can be seen I think.*

**Jean Marie DEBOIS**

*Just a small comment - I tried to be too short before. I should have mentioned that Russia, China and India - three large countries - also belong to the OECD codes. And indeed I think the way you put the question is quite valid. There is the competitive distortion, to be technical, between countries who subsidise and those who don't subsidise the testing and certification activities.*

**Sandro LIBERATORI**

*I would like to answer the question which was put before, concerning the problem that when you get a machine, it may be different from the machine that has been tested. Of course we will try to describe the machine as exactly as possible, in order to make it easy to recognise whether the machine you have in your country is the same as the machine that has been tested. Of course we cannot set up a system to check all machines everywhere. But we can provide a tool to help you recognise the machine.*

**Pierluigi FEBO**
**Italy**

*I have a question - I would like to hear more from the manufacturers, about what they really think of this certification activity. Because my previous experience of sixteen years of testing at the university of Milan, both for the OECD codes and the official Italian government, tells me that sometimes the manufacturers see this testing activity as time-consuming, expensive, and so on. What do they really think of this certification activity?*

**Jean Marie DEBOIS**

*I have an example from two weeks ago. There was a call for tenders for tractors from Pakistan. I won't tell you which countries were involved in that, but a key issue was whether the tractors had been OECD tested or not.*

**Lothar FISCHER**

*I would like to give you an answer, although I can only speak for John Deere in this case and not for the industry. For sure, there is no question that we need these tests. We don't need all of them, we need certain specific tests - they are helpful. However our problem is not only the money, it's also the timing, the time consumed. Because we have to stand in a line and wait for the test to be completed. And if the testing stations do specialise more than they are today, then the line will become longer. So what will happen, if the test stations believe that they can protect themselves in building up standards, and trying to keep the people busy by moving this one to station A and the other one to station B, is that the industry will go outside. Definitely. The big ones are international companies anyhow, and they can move anywhere. So I think also these organisations have to be more flexible, they have to cope with the situation on the market. We will find all this, but I have to say - and I say it frankly - we have good relations with the testing stations. No question about that.*

**Uri M. PEIPER**

*Before you answer I would like to add another short comment on this problem. We have very often encountered the problem that testing of agricultural machines takes an agricultural season, at least. And that prolongs the test procedure even without queuing up for other tests or competing on the manpower and facilities in the testing stations. This relates a little bit to what Dr. Fischer said. Please comment on that too, from your experience.*

**Hans-Hasso BERTRAM**

*Yes maybe in the past we needed about two years to finish a test completely. So our objective now is, if the machine comes in at the end of this year or at the beginning of the next year, to present the results at the end of the year - November. In this way the industry can use this test report as a marketing tool. This is the first point. We try to speed up the tests, by asking what is necessary to test, rather than what is possible to test. So we try to go back to the important criteria for the results at the end. Without testing all that is possible, as we used to do in the past. This means that tests will not necessarily take as much time as before. The third point is that maybe we have better test instruments and better test methods, which produce the results in a shorter time. In particular, this has been achieved in the testing of combine harvesters, for which we needed 10 persons in the past, whereas now only 4 to 5 persons are needed to do the job in a very short time: it's possible to test three machines in one and a half hours.*

**Giuseppe PELLIZZI**

*I should like to represent here in this moment the point of view of the farmers. Because the industry of course is not interested in this, but the farmers need to have information - objective information. And so we need to defend the farmers.*

**Jaime ORTIZ-CAÑAVATE**

*I don't think we have mentioned the European community machinery directive, which states that the industry has to make a self-certification of the machines they manufacture. So I think on task of the testing stations is to help the industry with this self-certification. And that will maybe lead to competition among the different testing stations, to help manufacturers achieve this goal.*

**Sandro LIBERATORI**

*The machinery directive provides for CE mark on the machine. For most agricultural machines it's a self-certification of the manufacturer. The machines that come to our testing station should already be CE marked. What we do after certification is of course an added value on the product. So it's something more than the CE mark and it's voluntary, not compulsory. And what we do during the test - we look at the machine, we check the machine, its safety, performance and so on. Concerning safety, sometimes there are problems. Because the machine may be CE marked, but when we check the machine we see that not all standards are met. In this case we contact the manufacturer, and try to find a solution. If there is a solution, then the manufacturer gets the full certification from CONAMA or DLG or the other institutions taking part in the agreement. If not, we don't issue any certification to the manufacturer. So we also provide a service, to help the manufacturer check whether the machine meets all existing standards.*

**Yoshisuke KISHIDA**

*I have one question about the European Network for Testing Agricultural Machinery. Do you intend to expand this network to other countries such as Russia and Eastern Europe, and so on?*

**Sandro LIBERATORI**

*At the moment it's a European Network of testing stations, but in the conclusions of our report Dr. Bertram said that it would of course be very very interesting if in the future it could become a wider network of testing stations. With European testing stations and testing stations from all other countries outside Europe.*

**Hermann AUERNHAMMER**

*My first question follows up on the question from Japan: at this time ENTAM is only a body of the European countries. Will all European member states come to ENTAM? That's one question, and the other one is: what about the possibility of another test procedure, by which a fully commercial non-agricultural organisation would conduct the tests for agricultural machinery?*

**Hans-Hasso BERTRAM**

*Of course, as I said it's a voluntary certification. So it's also voluntary to come inside ENTAM. I hope that in the future all European and non-European countries and testing stations will come into the agreement, but it's not compulsory. This is very clear. But on the second question - I didn't understand well, maybe you can repeat please.*

**Hermann AUERNHAMMER**

*At this time, the main money is coming from the governments. We have discussed the costs of tests for a long time now. We know from other sectors, other areas, that tests can also be conducted by fully commercial private organisations, which are specialised in testing. Could this not also be a way for testing agricultural machinery by non-agricultural organisations? I think it's a question for the future.*

**Hans-Hasso BERTRAM**

*In CONAMA for example, the manufacturer pays the full cost of the test. So it is also an example of a business-oriented testing activity. And I think that of course there will also be private bodies doing testing activities. But maybe for agricultural machines it's a very special sector, and we need very highly skilled testing stations. So perhaps a testing station that today may test a car or another product, and tomorrow an agricultural machine, cannot give the service that a testing station specialised on agricultural machines can give.*

**Chak CHAKKAPHAK**

*In some countries, in Asia in particular, this arrangement of farm machinery testing and certification has been set up. But many of us are in the early stages of establishing official testing. At present the manufacturers they are somewhat reluctant - they are not eager to send their machines for testing. So I would like to find out maybe some experiences from the floor - from Germany, from Italy, etc. Do you have any suggestions on this problem - since you have been in this operation for a long long time.*

**Gastão Moraes DA SILVEIRA**
**Brazil**

*I come from Brazil, and I work in a tractor testing station. And the relationship between industry in Brazil and the farmers is ... the Brazilian tractor industry has put pressure on the Agricultural Minister and closed one of the tractor testing stations. Now we have only one station that works only in the development. I think this is a problem: the pressure that industry puts on the government.*

**Lothar FISCHER**

*I would like to make two comments. I hope I do not misinterpret what you said about the relationship between the testing stations and the customer. It is the same customer to us as well. I heard you saying that industry has no interest in these tests. Yes we have interest, and I strongly believe that to build up a long lasting customer relationship can only be done with honest information. So I do not see a conflict. On behalf of what our Brazilian colleague just said: I'm not aware of what is going on in Brazil, but I don't understand why the industry would put pressure on closing testing equipment, rather than using them for the future. It doesn't make sense to close the stations. Maybe there are other reasons as well, but... we have a relationship in Brazil, and I can check whether they had an influence, but I don't think so.*

**Gastão Moraes DA SILVEIRA**

*To complement my previous comment, the industries that we have in Brazil for farm tractors are New Holland, SLC John Deere, AGCO, VALTRA. And they put pressure on the government Minister of Agriculture to close one of the testing stations.*

**Chan Joo CHUNG**
**Korea**

*The testing of agricultural machinery may be for the benefit of farmers. Of course certain tests may be useful for industry, for development. But the end user of the farm machinery must be assured by the government of the appropriateness of the farm machinery. So I think the procedure - the testing of farm machinery - should be done by the government. In our country now it's done by the government, but the industry does not want to test the agricultural machinery. Because it's time consuming, and they believe that they can still sell without the tests.*

**A. Mahmoud El HOSSARY**

*We in the developing countries really appreciate your testing methodologies. And sometimes we specify in our tenders that each machine which comes should be certified from a testing institution. But unfortunately, sometimes certain machines which are tested according to the European conditions - weather conditions - do not fit our conditions. Is there any possibility that you test some machines according to our requests, in our environmental and agricultural conditions? I believe there is a need for this. Because the end user is not only the European customer, but also customers from the third word. I will tell you one example: I was in Libya three years ago, where I found machines working very well, but sometimes there were failures caused by the high heat, and this reduced the efficiency of the machine. I believe that if there is a co-operation between both sides - we have testing stations in all this area - we could do a lot to modify the machines to suit the agricultural conditions of the developing countries.*

**Sandro LIBERAT*ORI***

*Maybe we can organise some specific tests for special or different conditions of use of machines. Because of course normal tests cannot be good for all the conditions in the whole world. Otherwise it would be a test lasting ten years maybe. But for specific markets we can give a service to the manufacturer and to the farmers of those markets, testing the machines according to our common methodologies including some extra tests.*

**Gajendra SINGH**

*India has quite an extensive testing set-up. We started following the OECD codes for testing tractors and sophisticated machinery in a test station in central India, and because the market is so big - and the Indian country is so big - we have set up four regional stations. One in north India, one in the eastern part of India, and one in south India. As a matter of fact the test is a must for tractors and bigger machinery. Without the test, or without acceptable results, farmers buying that machine do not qualify to get a bank loan which is at a reduced rate compared to the commercial rate. Because the commercial rate might around 16% now, while agricultural machinery loans are available at 9 to 10%. So I think there is an incentive there. Also, from time to time the government allocates a subsidy to promote certain types of equipment, which are considered to be useful in agriculture, and no item qualifies for subsidy without being properly tested. So I think that as long as there is an incentive or some kind of a promotion, it's easy. However for certain items - the smaller ones which manufacturers are selling directly to the farmers, testing is not compulsory if the farmers are not applying for a loan. Because they don't then see any reason for it, and the manufacturer also doesn't see a reason, if they can sell the thing and the farmer is willing to buy it.*

**Hugo CETRANGOLO**
**Argentina**

*I think the developing countries must pay attention to the testing and evaluation of agricultural machinery. Because it's the way to improve the quality of the agriculture, and also it's the way to not allow the importing of poor quality machinery. I want to tell you a story that was told to me by the director of the official test laboratory in Argentina. There was one tractor which was sold as having a 60 hp engine, and when they did the test it actually had less than 40 Hp. It was a very cheap tractor apparently, but it wasn't really. Because of that I think that testing is a way to improve the quality of the agricultural machinery in the developing countries.*

**Malcolm McKAY**

*In Australia there's a quite different view about testing and the need for testing. And it differentiates according to industries. We have a very defined system for motor vehicles, but nothing for agricultural machinery at all. The philosophy of government is that it is a "buyer beware" requirement, and that's supported by the very strong consumer protection legislation in terms of the commercial aspects of competition etc. And it's interesting to see that within Australia it would be quite illegal to undertake any sort of collusion on price. Quite often, organisations are actually prosecuted for what we call "price fixing" in Australia. The other aspect that gives protection is the product liability legislation, which is a very strong incentive for manufacturers of all types to actually make sure that their products are true to description. It's interesting that this is not necessarily the view held by farmers, because the farmer organisation - a group of farmers totally owned and subscribed to by farmers - actually undertakes some significant testing activities. However one of the limitations of that in years gone by has been that the standard of those tests, the professional conduct of those tests, has been rather questionable. And nevertheless it's been received by farmers as quite valuable information, albeit somewhat flawed from time to time.*

**Uri M. PEIPER**

*Since I have no more speakers on the list I will take a few minutes and give my comments on the problem of testing. In my experience of testing agricultural machinery, it was usually very easy for us to carry out tests on any machine for which there was a known and acceptable standard. Of course the OECD standards are accepted world-wide, and any machine which had an OECD test code was tested according to the OECD test code. Only the problem was that not many machines had these types of test codes, so in many cases we either had to devise our own test procedures or try to follow in the footsteps of DLG or other institutes and adapt their procedures to our needs. In my country - Israel - testing actually started before the state itself was born, and therefore there was no national test, this came much later. At the beginning foreign currency reserves were limited, and consequently the state imposed quite a lot of restrictions on which machines could be imported. And that gave a lot of strength to the machinery testing laboratory, because we had to determine which machine was better for the local market. This is no longer the case - fortunately the economic situation has improved quite a lot and we are now in competition. Now the tests are mostly voluntary, although not all of them - and there are still some cases where the government subsidises certain agricultural activities, like investments in greenhouses in certain areas. So we still have compulsory testing of some types of equipment, which then go as certified into a certain list, and when farmers buy this type of equipment they get some help from the government in their investment. The length of the time taken by an agricultural machinery test is a big problem. Computer technology, automation and all the new facilities for testing should make it shorter, and we too can test several combines in one day. But having so many different types of weather and soil conditions, field performance tests have to be carried out in various places around the country. So it does take time. And the industry, or the dealers, are unwilling to pay for some of the tests. They don't like it so much. So there is always a conflict - which actually is good because this is what makes things go forward and develop into better conditions in the*

*future. The standards - the national or international standardisation - on one side, and the manufacturer on the other, who of course knows the standard because the standard is usually defined in concert with industry or is accepted by the industry, brings us back to the student and professor question. Does the industry go along with the test code, and how far does the test code really cover all situations? This is probably the reason why there are so few internationally known test codes. Because a tractor will probably react in the same way in many places, whereas a plough will react quite differently. I can assure you that fields which are ploughed in our country would never be ploughed anywhere else, because we have such a shortage of land. So we do stress the machines and the ploughs very very much. These are, more or less in short, my comments on testing, and I would like to take this opportunity to draw your attention to Agritech 99 agricultural technical exhibition in Israel, which is going to be held in September 1999, and I invite you all to be our guests there.*

**Theodor FRIEDRICH**

*I think that, with the comments from Australia and from Dr. Peiper, we are now touching on quite an interesting topic: the question of what really needs to be tested and under what conditions. We from FAO are frequently getting in situations where countries think that everything that comes into the country should be tested - more or less based on the argument we've just heard from Argentina, to protect their farmers from low quality. On the other side, we believe that farmers figure out fairly quickly what a machine is like in terms of quality - what the real quality is. Well, some farmers might bite the bullet and lose out in the process, but in general on a national or global scale, this sort of information is spreading fairly quickly, and we believe that in most of those cases market forces could actually sort out the problems of quality and durability, especially in a real free market with price differentials. But there is certainly a connection with the legislation of each country. Australia mentioned consumer protection laws, and this kind of legislation also makes it much easier for the farmer to react in case of real fraud, which in other countries might not be covered by the legislation path. But we still believe that legislation, and confining mandatory testing or standardisation to the truly essential aspects that are not covered by market forces, like safety and the environment, is the better way to go about it. If then the consumer and the manufacturer still feel that they need testing, as is the case in Europe - and it is I think a useful instrument - then we should go to the sort of self-financing testing arrangements where all the interested parties really contribute to the test and to the quality. Because if we leave the testing to government institutions just to protect their markets, we find in many countries governments discover testing is expensive, so in the long run we get a lower quality just because the governments can't pay for the testing in the long term.*

**Hermann HEEGE**

*I have thought about the relationship between testing and the size of the farm machinery industry. In Europe the farm machinery industry consists mainly of medium sized enterprises, and also quite a lot of small enterprises. In the States it's big enterprises, huge enterprises mainly, and testing is quite common in Europe, while testing isn't done much in the States as far as I know. And so I'm thinking whether there is a relationship between the size of the machinery manufacturers and the existence of testing. And I would like to ask Dr. Liberatori or Dr. Bertram whether they see a relationship here.*

**Hans-Hasso BERTRAM**

*I think that's right, that the market is changing in Europe too, and we have to deal with big manufacturers. It's the same in Germany. But at the moment they are interested in test results, and these manufacturers ask us to have international - or European - results which they can use in other countries too. In particular, John Deere have asked us if it is possible to have results which can also be used in France. As regards the States - yes to the extent that the machines are sold in the States. But we have a lot of machines that are produced in Europe and are merchandised in Europe. Let's not speak*

*about tractors but about combines, if they are built in Europe they remain in Europe. And the same is true for mowers and mower-conditioners and so on.*

**Bernard CHEZE**

*A small comment on what was said about the fertiliser testing laboratories. It's certain that you have very well established and famous laboratories, but I was told that for fertilisers for example, different countries do not use the same types of fertilisers. That can be a limitation to the idea of having just one specialised testing centre. If you consider the importance of the type of granular etc. on the performance of fertiliser spreading machines, this is part of the limitation of the idea. The idea is good but it may meet with some difficulties in certain cases. And just to make a historical point - I believe the first testing station in the world for agricultural machinery was established on the 23 September 1888 in Paris, France. Actually, I'm just putting that out to see if someone says that they started first - just to check whether it was really the first. I'm not very sure about that. And CEMAGREF is going to celebrate this next year and I think you will be invited, most of the testing centres, to share this celebration.*

**Sandro LIBERATORI**

*We spoke about the mineral fertilisers before. But we chose the Danish station because they have the equipment to make many many tests in a very short time. And it's the only testing station equipped to do this in Europe. So of course there are many different types of fertilisers that are used in Europe, and therefore we need a testing station that is well equipped and can do the test very quickly in order to use as many types of fertilisers as possible. So we choose a standard test, using some kinds of fertilisers and some options. And the options can be as many as the manufacturers wants, in order to test all the types of fertilisers that are used in Europe. And for us such a test is very difficult because in Italy we don't have equipment like the have in Denmark, and it would be too expensive to test all the kinds of fertilisers in Italy. It is much cheaper to go to Denmark and do the tests there.*

**Richard HEGG**

*Let me respond briefly to the question from the U.S. perspective. This is not my background area - but much of what Prof. McKay said is very similar to situation in the United States. From the tractor standpoint there is testing, but from the equipment standpoint there are liability situations. So that if a manufacturer produces equipment that is defective structurally, or from a safety standpoint, we have many lawyers in the United States who are happy to undertake proceedings in order to satisfy the customer. So the industry has to be in a position to respond to that. Consequently the equipment manufacturers will in many cases do their testing on the farm or in conjunction with the farmer. And if the equipment goes out, has problems or corrections that need to be made, the manufacturer will often follow up and make those corrections - probably on a no cost basis because you're at the initial stages of that equipment. I just wanted to amplify on that.*

**Uri M. PEIPER**

*While visiting a testing station in Canada. I asked them: how do you manage to produce such beautiful test reports? - because they really have beautiful test reports, and the man said to me, well that's very easy. For six months of the year we cannot go outside, we cannot go out of the room! So for half a year we have time to prepare beautiful test reports on the work we do during the other half of the year. And with this I close this session of testing of agricultural machinery. Let us give a big hand to the speakers and thank all of the participants. And now Mr. President the floor is yours.*

# SESSION 3

## Tractor industry in India

**Chairman : Giuseppe Pellizzi, Italy**

# Tractor industry in India

by ***Gajendra Singh***
INDIA

## 1. Introduction

Agricultural mechanization made a small beginning with the introduction of imported tractors and by acquiring war surplus tractors and bulldozers for undertaking, basically, land reclamation and to some extent mechanical cultivation. In 1947, Central Tractor Organization and a few State Tractor Organizations were set up, which, during 1947-1959, reclaimed about one million hectares of land. This in turn created demand for tractors to undertake follow up cultivation in the reclaimed areas. The number of tractors in use estimated by [1] was 8,500 in 1951, 20,000 in 1955 and 37,000 in 1960. Up to 1960, the annual demand of tractors was met entirely through imports.

When planned economic development of the country was launched in 1951, tractor industry was included in the "Core Sector" which indicated its strategic importance. Its growth and development policies were, therefore, reviewed on Plan to Plan basis. As in the case of all other industries, farm equipment industry had to follow the legislation enacted under Industrial Development and Regulation Act, 1951, the main features of which were:

- reservation of certain sectors of core and heavy industry for the Government i.e., steel, machine-tools, aircraft, etc.;
- reservation of certain class of items exclusively for the defined small scale sector;
- necessity of obtaining an industrial license from the Government of India for manufacturing any new article when capital investment in land and building exceeds Rs 1.0 million;
- phased local manufacturing program;
- imported plant and machinery;
- technical experts from collaborators and training of Indian counterparts.

A policy of protection of domestic industry was introduced, wherein; imports were totally prohibited if local manufacturing capabilities were adequate for meeting demand. Import tariffs were levied in other cases where local manufacturing, though set up, was inadequate, necessitating imports. As industrialization progressed, exemptions from licensing were liberalized first to Rs 10.0 million, than to Rs.30.0 million, and further to Rs 50.0 million. During 1992-96, licensing was further liberalized and most of the industries were de-licensed. Development Councils for various sectors of industry were also set up at the national level to advise the Government on the steps to promote and foster industry. The growth of the Farm Equipment Industry in India has to be viewed in the backdrop of this national scenario.

## 2. Tractor industry: 1961 -70

Development of the tractor industry in the sixties was dictated by the anxiety to promote mechanization of agriculture by encouraging local manufacturing of tractors and at the same time, protecting the interest of farmers by making them available tractors at the reasonable prices. The tractor manufacturing in India started in 1961. The names of the units, their collaborators and the year of commencement of local manufacture are given in **Table 1**. First four entrepreneurs were representing trading houses as dealer or sub-dealer of tractors, the fifth, Mahindra & Mahindra, was a major player in the automobile sector. These units were licensed in 1960-61 with aggregate capacity to manufacture 11,000 tractors. Though all these units went into production subsequently, it was noted that pace of installation of production capacity was slow. On the other hand, the demand of tractors was increasing at a steep rate and expected to grow further in the ensuing years. Besides considering industrial licenses to add the additional production capacity, import of tractors continued to meet the demand of farmers. As the

the demand of farmers. As the prices of tractors imported from the East European countries were lower than locally manufactured tractors, the duties on imported component were raised to 40%. Simultaneously, to protect the interest of farmers in the situation of acute shortage of tractors Government imposed statutory control on the selling prices of indigenously manufactured tractors in 1967. However, this control was withdrawn in October 1974 when the supply position was eased. To meet the growing demand, the Government decided to invite additional entrepreneurs into tractor manufacture in 1968. As given by [2], the production of tractor started in 1961 with 880 units which rose to over 5000 units in 1965 and crossed 20,000 units in 1970 (**Table 2**). There were about 52,000 tractors in use in 1965, which increased to 146,000 tractors in 1970.

### 3. Tractor industry: 1971-1980

The Government decision to invite new entrepreneurs to manufacture tractors in 1968 and the sudden upsurge in demand due to Green Revolution led to a flood of requests for new collaborations. Of these only 6 units established the manufacturing facilities (number 6 to 11 in **Table 1**). Escorts established Escort Tractors Limited and started manufacturing Ford tractors in 1971 in collaboration with Ford, U.K. Three of these units, namely, Kirloskar Tractors, Harsha Tractors and Pittie Tractors could not survive and closed down their plants. During this period, the emphasis was on indigenous production of the tractors and the Government extended full support to old and new entrepreneurs to establish local manufacture. The credit facilities to the farmers for the purchase of tractors were increased and liberalized to enlarge the market. The import of tractors, both fully built and in CKD form to new entrepreneurs was continued. Because of oil crisis in 1973, and the resultant economic crisis, the import of fully built tractors was banned in 1973 except under specific World Bank Projects and CKD import to new entrepreneurs in the process of entrepreneurs in the process of establishing local production facilities. With more manufacturers entering in the field in a stagnant demand situation, the market became intensely competitive from 1973 onward. The Statutory Price Control on tractors was lifted in October 1974. As a result of Government directive to the commercial banks to increase their proportion for rural lending, the commercial banks opened branches in rural areas. This action was supported by availability of refinance facilities to commercial banks for agricultural development from National Bank for Agriculture and Rural Development. Credit available to farmers increased significantly and the tractor market expanded rapidly from the beginning of 1977. The production of tractors more than doubled during a five year period. It was 33,000 units in 1975 and increased to over 71,000 units in 1980 (**Table 2**). The number of tractors in use also crossed 500,000 units mark.

### 4. Tractor industry: 1981-90

The expansion in the tractor market during late seventies led to the setting up five more units for the manufacture of tractors. One of these was in the public sector in collaboration with an U.K. firm and the rest were in the private sector. Only one firm in private sector had collaboration with an outside (Romanian) firm and others used indigenous know-how. These units are listed in **Table 1** at serial numbers 12 to 16.

After having attained complete indigenous production by most of the already established tractor units, the post 1980 period was marked by increased production from all units. However, except VST Tillers & Tractors, other four newly established units during eighties could not sustain the market competition and closed their plants. In order to make available tractors to the farmers with small holding of land, the Government exempted production tax (excise duty) for tractors of 9 and lower drawbar kW. This exemption was extended to the tractors fitted with engine not exceeding 1800 $cm^3$

subsequently. This phase of industry was comprised of consolidation and up-gradation of technology to improve the quality of products. The Working Group in the Ministry of Industry and later on a Group in the Ministry of Agriculture, recommended to improve fuel efficiency of tractors by fixing norms of specific fuel consumption at power take-off shaft. They also recommended improving the parameters of noise and vibration levels, emission levels, ergonomics and safety aspects. The industry grew slowly in the early eighties and produced about 75,000 tractors in the year 1985 (**Table 2**). In the later half of eighties industry grew very fast and produced almost 140,000 tractors in 1990 (**Table 2**). The number of tractors in use in India reached one million units mark in 1989 and in 1990 the population of tractors was estimated to be 1.2 million units. Export of tractors mainly to the African countries, also started in the eighties. Thus, India, a net importer up to mid seventies became an exporter during eighties.

## 5. Tractor industry: 1991-98

Indian industry has seen a remarkable change from a complete protection in early days to a competition in the international market during nineties. Government approval and obtaining industrial license for manufacture of tractor was dispense with in 1992. The foreign companies can also take up tractor production in India, after following prescribed procedure or obtaining approval from the Government. However, import of fully built up tractor has been restricted presently and the same can be imported against import license or public notices issued in this behalf. Credit facilities to the farmers for the purchase of tractors have been continued. The collaboration of Escorts with Ford came to an end in 1994 and Escorts started to produce Farmtrac tractor in place of Ford tractor. Haryana Tractors (S. number 13 in **Table 1**) has been producing tractors on a very irregular basis. Bajaj Tempo started manufacturing in 1997 and International Tractors (Sonalika) has started production in 1998. The production of tractors from all units during 1997 was over 255,000 units (**Table 2**). The number of tractors in use in India at the end of 1997 was estimated to be over two million units.

## 6. Present status and future plans of tractor industry

Tractor manufacturing industry is now well established in India. Out of the sixteen units who took up manufacturing before 1990, six units, namely, Eicher, Escorts, HMT, Mahindra & Mahindra, PTL and TAFE are major manufacturers (**Table 3**). Out of the six units, five were set up with foreign col-laborations and one with the indigenous know-how (Punjab Tractors). Therefore, it may be said that the establishment and the present status of the tractor industry in India owe a great deal to the foreign collaborators who supported the Indian entrepreneurs during initial phase of manufacture. All these six units are now on their own and having mastered the manufacturing technology of tractor, have developed capabilities to expand their base further. Ancillaries have also been well established and the industry is no longer dependent on import of components or systems. Mahindra & Mahindra has emerged as the largest manufacturer with about 68,000 tractors produced in 1997. TAFE and Escorts with about 49,000 and 48,000 units each follow it, respectively. The Punjab Tractors produced over 40,000 units.

Three manufacturers who are likely to start production in near future are listed at serial numbers 19 to 21 in **Table 1**. New Holland Tractor (India) launched 50 kW Ford tractors with matching equipment in April 1998. The company is making US$ 75 million initial investment in a state of the art plant in Greater NOIDA, Uttar Pradesh with an initial capacity to produce 35,000 tractors annually. The Larsen & Toubro (L&T) is establishing a joint venture with John Deere of the USA. This joint venture will manufacture 25-50 kW tractors in a plant in Pune, Maharashtra. SAME Deutz-Fahr, Italy is developing a joint venture with Greeves Limited to produce

SAME brand of tractors. Case and M&M are developing a joint venture for producing tractors in the range of 45-150 kW for the export to South America. With the entry of new European tractor manufacturers into India, technology and sophistication is expected to improve further in the near future. The production is expected to rise to an estimated level of about 300,000 tractors by the year 2000.

The growth of physical output of tractors is accompanied by a significant increase in the number of models produced with different horsepower ranges to meet the diverse needs of the farmers. For instance, during initial years, when the production of tractors began in the country only a few models were produced and the same have now increased to over 40 numbers, in the power range of 11 kW to 50 kW at power take-off shaft. A few technical details of the tractor models produced in India are given in **Table 4**. The increase in the power range is a reflection of the preference of the tractor purchasers, which is composed of large, medium and small farmers as well as entrepreneurs who provide custom hire services.

## 7. Power tiller industry

The import of power tillers started in 1961 and continued till 1974. A total of 12,211 power tillers were imported from Japan during this period (**Table 5**). Initially, six manufacturers were given license to make 40,000 power tillers annually (**Table 6**). Krishi Engines limited; Hyderabad was the first manufacturer to start the production of Krishi power tillers in 1965. In 1970, three manufacturers, namely, VST Tillers & Tractors Limited (Mitsubishi), Maharashtra Co-operative Engineering Society (Yanmar) and Kerala Agro-Machinery Corporation (Kubota) started production of power tillers. Production of Yanmar power tillers was discontinued in 1977. In 1971 Indequip Engineering limited started production of Iseki power tillers and discontinued production in 1977. The J K Satoh Agricultural Machines limited started limited started production of Satoh power tillers in 1973 and discontinued production in 1985. Production of Krishi power tiller was discontinued in 1986. The Bihar Agro-Industries started producing Kubota power tillers in 1975 but discontinued production in 1989. The National Engineering Company started producing National power tiller in 1984 and closed production in 1989. The Dogar Tools Private Limited started production of Universal power tiller in 1984 and stopped production in 1994. Details on manufacturers are given in **Table 6**. At present there are only two well established manufacturers, namely, VST Tillers & Tractors Limited, Banglore and Kerala Agro-Machinery Corporation, Ernakulam producing about 10,000 power tiller units per year.

Recently a new manufacturer, Kalinga Engineers Limited, Bhubaneshwar has started to produce 3-HP power tiller in small quantities. Another manufacturer, Field Worthy Equipment Pvt. Ltd., Ahmedabad, Gujrat is also planning to produce a 5-HP power tiller. A number of companies in West Bengal and Tamilnadu are importing power tillers from China.

Though there is encouraging trend in the production of power tillers the present production of 10,000 units per year is only 25% of the installed capacity of 40,000 units. In the recent past sale of power tillers has increased significantly and the situation is highly favorable with the introduction of subsidy by the central government and many state governments. Development of several new matching equipment and R&D support by ICAR are contributing towards increased use of power tillers.

## 8. Population of tractors and power tillers

Annual production and annual sale of tractors and power tillers are given in **Table 2** and **Table 5**, respectively. Data on annual sales of tractors during last five decades clearly show that these sales have more than doubled in each next decade. It is expected that by the year 2000 the sale of tractors in India will be

around 300,000 units. Assuming the life of tractors as 15 years and power tillers as seven years, based on their sales, the population of tractors and power tillers in different states was estimated. The population density of tractors and power tillers was computed by dividing their respective numbers by the agricultural land area of a state. These population densities of tractors and power tillers as units per 1000 ha for different states are given in **Table 7**. It is clear that in 1997 Punjab had the highest density of tractors with 82 tractors per 1000 hectare. This was followed by neighboring states of Haryana (63 tractors per 1000 ha) and Uttar Pradesh (24 tractors per 1000 ha). Although the sale of power tillers has been rather small in India most of these have gone to rice growing states like West Bengal, Tamil Nadu, Karnataka, Assam, Kerala and Andhra Pradesh.

The easy availability of the agricultural credit has contributed significantly towards growth of the tractor industry, as more than 90% tractors are sold on credit. The Reserve Bank of India has also proposed to increase the capital of the National Bank for Agriculture and Rural Development (NABARD) from Rs 5,000 million to Rs 20,000 million to help it meet the needs of rural sector better. Punjab with over 80 tractors per 1000 ha has reached a saturation situation and will have mainly a replacement market. Haryana, with over 60 tractors per 1000 ha, will reach a similar position in next five years. The sale of tractors will continue to be very high in northern and western India, especially in Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Rajasthan, Gujrat and Maharashtra. The sale of tractors is expected to increase significantly in southern states, namely, Andhra Pradesh, Karnataka and Tamilnadu.

The average size of tractor in India at present is about 25 kW. The average size is expected to increase slowly to 35 kW in year 2020. The present population of two million tractors in India is expected to increase to about five million in 2020. The annual sale of tractors in India is expected to increase to about 320,000 units. The average size of power tiller in India at present is about 7 kW. The present population of 66,000 power tillers is expected to grow quite rapidly to 300,000 units in 2020 with annual sales reaching over 50,000 units.

## References


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**Table 1** List of tractor manufacturers, their collaborators and the year of commencement of production

| | MANUFACTURER | COLLABORATOR | YEAR |
|---|---|---|---|
| 1 | Eicher Tractors Ltd. | Gebr, Eicher Tractorenfabrik, West Germany | 1961 |
| 2 | Gujarat Tractors Ltd./Tractors and Bulldozers Ltd. | Motokov-Praha, Czechoslovakia | 1963 |
| 3 | Tractor and Farm Equipment Ltd. | Messey Ferguson, UK | 1961 |
| 4 | Escorts Ltd. | Moloimport Warazawa Zaklady Mechaniczne Ursus, Poland | 1964 |
| 5 | Mahindra & Mahindra Ltd./ International Tractor Co. of India Ltd. | International Harvesters, UK | 1965 |
| 6 | (*)Escorts Tractor Ltd. / Escorts Ltd. (Farmtrac Division) | Ford, UK | 1971 |
| 7 | Hindustan Machine Tools Ltd. (Central Sector PSU) | Motokov-Praha, Czechoslovakia | 1971 |
| 8 | (#) Kirloskar Tractors Ltd. | Klochner-Humboldt Deutz, Germany | 1974 |
| 9 | Punjab Tractors Ltd. (State Sector) | CMERI, India | 1974 |
| 10 | (#) Pittie Tractors Ltd. | Own know-how | 1974 |
| 11 | (#) Harsha Tractors Ltd | Motoimport, Russia | 1975 |
| 12 | (#) Auto Tractors Ltd. | British Leyland, UK | 1981 |
| 13 | (§) Haryana Tractors Ltd. / Pratap Steel Rolling Mills Ltd. | Own know-how | 1983 |
| 14 | VST Tillers & Tractors Ltd. | Mitsubishi, Japan | 1983 |
| 15 | (#) United Auto Tractors Ltd. | Uzina Tractorul, Romania | 1986 |
| 16 | (#) Asian Tractors Ltd. | Own know-how | 1989 |
| 17 | Bajaj Tempo Ltd. | Own know-how | 1997 |
| 18 | International Tractors (Sonalika) Ltd. | Own know-how | 1998 |
| 19 | New Holland Tractor (India) Pvt. | New Holland Tractors, Italy | (°) |
| 20 | Larsen & Tubro Ltd. | John Deere, USA | (°) |
| 21 | Greaves Ltd. | Same Deutz-Fahr, Italy | (°) |

Note: (*) now producing Farmtrac tractors;
(#) currently not in production;
(§) have been producing small quantities on "On & Off" basis;
(°) product under test and evaluation.

**Table 2** Production, sale and population of tractors in India

| YEAR | PRODUCTION | IMPORT | EXPORT | SALE | POPULATION (*) |
|---|---|---|---|---|---|
| Up to 1946 | 0 | 4,500 | 0 | 4,500 | 4,500 |
| 1947-51 | 0 | 4,000 | 0 | 4,000 | 8,500 |
| 1952-56 | 0 | 12,500 | 0 | 12,500 | 21,000 |
| 1957-60 | 0 | 16,000 | 0 | 16,000 | 37,000 |
| 1961 | 880 | 2,997 | 0 | 3,877 | 39,000 |
| 1962 | 1,414 | 2,616 | 0 | 4,030 | 41,000 |
| 1963 | 1,983 | 2,346 | 0 | 4,329 | 43,000 |
| 1964 | 4,323 | 2,323 | 0 | 6,646 | 47,000 |
| 1965 | 5,673 | 1,989 | 0 | 7,662 | 52,000 |
| 1966 | 8,816 | 2,591 | 0 | 11,407 | 62,000 |
| 1967 | 11,394 | 4,038 | 0 | 15,432 | 76,000 |
| 1968 | 15,466 | 4,726 | 0 | 20,192 | 93,000 |
| 1969 | 18,093 | 10,478 | 0 | 28,571 | 118,000 |
| 1970 | 20,099 | 13,300 | 0 | 33,399 | 146,000 |
| 1971 | 18,100 | 19,739 | 0 | 37,839 | 176,000 |
| 1972 | 20,802 | 1,000 | 0 | 21,802 | 210,000 |
| 1973 | 24,425 | 1,000 | 0 | 25,425 | 228,000 |
| 1974 | 31,088 | 793 | 0 | 31,881 | 256,000 |
| 1975 | 33,252 | 1,100 | 0 | 34,352 | 287,000 |
| 1976 | 33,146 | 2,920 | 0 | 36,066 | 319,000 |
| 1977 | 40,946 | 0 | 0 | 40,946 | 356,000 |
| 1978 | 54,322 | 0 | 0 | 54,322 | 406,000 |
| 1979 | 62,275 | 0 | 0 | 62,275 | 462,000 |
| 1980 | 71,024 | 0 | 0 | 72,012 | 526,000 |
| 1981 | 84,137 | 0 | 0 | 79,467 | 594,000 |
| 1982 | 63,155 | 0 | 0 | 65,776 | 644,000 |
| 1983 | 75,872 | 0 | 0 | 76,545 | 701,000 |
| 1984 | 84,876 | 0 | 0 | 82,390 | 754,000 |
| 1985 | 75,550 | 0 | 0 | 76,817 | 798,000 |
| 1986 | 80,369 | 0 | 0 | 80,670 | 841,000 |
| 1987 | 92,092 | 0 | 0 | 92,092 | 911,000 |
| 1988 | 109,987 | 0 | 0 | 109,987 | 996,000 |
| 1989 | 121,624 | 0 | 0 | 121,624 | 1,085,000 |
| 1990 | 139,831 | 0 | 458 | 139,373 | 1,190,000 |
| 1991 | 150,556 | 0 | 583 | 149,973 | 1,304,000 |
| 1992 | 144,350 | 0 | 1,174 | 143,601 | 1,407,000 |
| 1993 | 138,770 | 0 | 1,498 | 138,057 | 1,491,000 |
| 1994 | 164,841 | 0 | 3,038 | 164,309 | 1,593,000 |
| 1995 | 191,329 | 0 | 3,454 | 191,196 | 1,712,000 |
| 1996 | 221,689 | 0 | 3,719 | 220,941 | 1,853,000 |
| 1997 | 255,327 | 0 | 7,000 | 250,378 | 2,038,000 |

Note: (*) Based on estimated life of 15 years

**Table 3** Tractor sales of major manufacturers. The data include sales from April of the stated year to March of next year

| COMPANY/MAKE | 1995 | 1996 | 1997 |
|---|---|---|---|
| Eicher | 21,875 | 23,129 | 24,255 |
| Escorts ( + Farmtrac) | 38,597 | 43,442 | 48,329 |
| Gujrat (Hindustan) | 1,807 | 1,354 | 1,115 |
| H.M.T. | 16,981 | 19,018 | 19,275 |
| Mahindra & Mahindra | 50,005 | 57,379 | 67,779 |
| Punjab (Swaraj) | 26,315 | 33,034 | 40,245 |
| TAFE | 36,370 | 43,585 | 49,160 |

**Table 4** Model, power range and indicative price of tractors in 1997

| MODEL | | ENGINE | | MAX. PTO POWER | SFC AT MAX. POWER | WEIGHT/ PTO POWER | PRICE (*) (SEP 30,98) |
|---|---|---|---|---|---|---|---|
| | | Cylinders (n.) | Capacity ($cm^3$) | (kW) | (g/kWh) | (kg/kW) | (Rs) |
| 1 | Mahindra 225 DI | 2 | 1261 | 12.0 | 271 | 142.92 | 176,950 |
| 2 | Mahindra 265 DI | 3 | 1788 | 22.8 | 249 | 76.10 | 200,395 |
| 3 | Mahindra B-275 DI | 3 | 1892 | 23.3 | 256 | 74.68 | 215,383 |
| 4 | Mahindra 365 DI | 3 | 1810 | 21.9 | 255 | 78.54 | 208,797 |
| 5 | Mahindra 475 DI | 4 | 2384 | 29.0 | 238 | 61.38 | 235,730 |
| 6 | Mahindra 575 DI | 4 | 2523 | 31.2 | 233 | 59.94 | 264,308 |
| 7 | Swaraj 724 FE | 2 | 1728 | 16.0 | 259 | 107.81 | 170,500 |
| 8 | Swaraj 735 FE | 3 | 2592 | 25.1 | 250 | 73.11 | 211,000 |
| 9 | Swaraj 855 | 3 | 3308 | 33.9 | 257 | 57.27 | 263,000 |
| 10 | Escorts 325 M | 2 | 1795 | 16.6 | 288 | 100.00 | 174,7000 |
| 11 | Escorts 335 M | 2 | 1960 | 20.9 | 250 | 83.97 | 200,500 |
| 12 | Escorts 340 M | 3 | 3120 | 33.2 | 339 | 54.97 | 228,000 |
| 13 | Escorts 355M | 3 | 2727 | 29.6 | 245 | 62.67 | 247,000 |
| 14 | Farmtrac 50 | 3 | 2868 | 31.0 | 297 | 59.35 | 269,000 |
| 15 | Farmtrac 60 | 3 | 3147 | 33.3 | 253 | 59.31 | 298,000 |
| 16 | TAFE 25 DI | 2 | 1670 | 17.7 | 269 | 90.41 | 176,340 |
| 17 | TAFE 30 DI | 3 | 1788 | 25.1 | 258 | 65.74 | 213,273 |
| 18 | TAFE 1035 DI | 3 | 2365 | 24.9 | 243 | 65.66 | 218,738 |
| 19 | MF 245 | 3 | 2500 | 30.5 | 256 | 58.20 | 256,475 |
| 20 | Eicher 241 NC | 1 | 1557 | 15.1 | 262 | 109.93 | 162,075 |
| 21 | Eicher 242 NC | 1 | 1558 | 14.1 | 267 | 114.54 | 165,620 |
| 22 | Eicher 312 | 2 | 1790 | 20.3 | 259 | 85.47 | 184,745 |
| 23 | Eicher 364 NC | 2 | 1963 | 22.9 | 272 | 76.20 | 204,035 |
| 24 | HMT 2522 Edi | 2 | 1560 | 16.1 | 266 | 102.48 | 180,950 |
| 25 | HMT 3511 | 3 | 2340 | 22.5 | 254 | 84.44 | 211,214 |
| 26 | HMT 4511 | 3 | 2698 | 30.5 | 274 | 69.67 | 249,381 |
| 27 | HMT 5911 | 4 | 3456 | 37.2 | 264 | 63.71 | 312,391 |
| 28 | Hindustan G 312 | 2 | 1798 | 18.7 | 271 | 91.18 | 133,184 |
| 29 | Hindustan G 453 DI | 3 | 2697 | 32.3 | 290 | 61.61 | 242,903 |
| 30 | Hindustan Super | 4 | 4160 | 39.2 | 285 | 68.88 | 277,902 |
| 31 | Hindustan G 614 | 4 | 4667 | 48.9 | 277 | 55.52 | 307,066 |

Note: (*) US$1= 42 Indian Rupees (Rs)

**Table 5** Production, sale and population of power tillers in India

| YEAR | PRODUCTION | IMPORT | EXPORT | SALE | POPULATION (*) |
|---|---|---|---|---|---|
| 1961 | 0 | 2 | 0 | 2 | 2 |
| 1962 | 0 | 22 | 0 | 22 | 24 |
| 1963 | 0 | 12 | 0 | 12 | 36 |
| 1964 | 0 | 173 | 0 | 173 | 209 |
| 1965 | 329 | 983 | 0 | 1,312 | 1,521 |
| 1966 | 577 | 1,101 | 0 | 1,678 | 3,199 |
| 1967 | 171 | 1,271 | 0 | 1,442 | 4,641 |
| 1968 | 286 | 994 | 0 | 1,280 | 5,919 |
| 1969 | 314 | 961 | 0 | 1,275 | 7,172 |
| 1970 | 1,387 | 1,030 | 0 | 2,417 | 9,577 |
| 1971 | 1,081 | 2,523 | 0 | 3,604 | 13,008 |
| 1972 | 1,199 | 1,072 | 0 | 2,271 | 13,967 |
| 1973 | 1,526 | 1,107 | 0 | 2,633 | 14,922 |
| 1974 | 2,142 | 960 | 0 | 3,102 | 16,582 |
| 1975 | 2,617 | 0 | 0 | 2,617 | 17,919 |
| 1976 | 1,949 | 0 | 0 | 1,949 | 18,593 |
| 1977 | 1,602 | 0 | 0 | 1,602 | 17,778 |
| 1978 | 2,297 | 0 | 0 | 2,297 | 16,471 |
| 1979 | 2,576 | 0 | 0 | 2,576 | 16,776 |
| 1980 | 2,125 | 0 | 53 | 2,072 | 16,215 |
| 1981 | 2,352 | 0 | 59 | 2,293 | 15,406 |
| 1982 | 2,248 | 0 | 140 | 2,108 | 14,897 |
| 1983 | 2,751 | 0 | 107 | 2,644 | 15,592 |
| 1984 | 4,244 | 0 | 184 | 4,060 | 18,050 |
| 1985 | 3,917 | 0 | 21 | 3,896 | 19,649 |
| 1986 | 3,527 | 0 | 0 | 3,527 | 20,600 |
| 1987 | 3,258 | 0 | 0 | 3,258 | 21,786 |
| 1988 | 4,923 | 0 | 0 | 4,923 | 24,416 |
| 1989 | 5,324 | 0 | 10 | 5,314 | 27,622 |
| 1990 | 6,194 | 0 | 11 | 6,183 | 31,161 |
| 1991 | 7,573 | 0 | 60 | 7,513 | 34,614 |
| 1992 | 8,743 | 0 | 22 | 8,721 | 39,439 |
| 1993 | 9,406 | 0 | 96 | 9,310 | 45,222 |
| 1994 | 8,315 | 0 | 294 | 8,021 | 49,985 |
| 1995 | 10,375 | 0 | 256 | 10,119 | 55,181 |
| 1996 | 10,048 | 0 | 3 | 10,045 | 59,912 |
| 1997 | 12,200 | 0 | 0 | 12,200 | 65,929 |

Note: (*) Based on estimated life of 7 years

**Table 6** Power tiller manufacturers in India

| | MANUFACTURER | MAKE | SIZE (HP) | YEAR OF RODUCTION | |
|---|---|---|---|---|---|
| | | | | Started | Closed |
| 1 | Krishi Engines Ltd., Hyderabad | Krishi | 5-8 | 1965 | 1986 |
| 2 | VST Tillers & Tractors Ltd., Banglore | Mitsubishi | 8-10 | 1970 | Continuing |
| 3 | Maharashtra Co-op. Engg. Society, Kolhapur | Yanmar | 8-12 | 1970 | 1977 |
| 4 | Kerala Agro Machinery Corp. Ltd., Ernakulam | Kubota | 8-12 | 1970 | Continuing |
| 5 | Indequip Engineering Ltd., Ahmedabad | Iseki | 5-7 | 1971 | 1977 |
| 6 | J K Satoh Agricultural Machines Ltd., Kanpur | Satoh | 7-9 | 1973 | 1985 |
| 7 | Bihar Agro-Industries Corp. Ltd., Patna | Kubota | 8-12 | 1975 | 1989 |
| 8 | National Engineering Company, Chennai | National | 6.5 | 1984 | 1989 |
| 9 | Dogar Tools Private Ltd., Raipur | Universal | 6.5 | 1984 | 1994 |
| 10 | Kalinga Engineers Ltd., Bhubaneshwar | Kalinga | 3 | 1997 | Starting |

**Table 7** Population and density of tractors and power tillers, 1997

| STATE | AGRI. LAND | TRACTOR | | POWER TILLER | |
|---|---|---|---|---|---|
| | 1000 ha | Population | Density/000 ha | Population | Density/000 ha |
| Andhra Pradesh | 14,460 | 100,067 | 6.92 | 3,564 | 0.22 |
| Assam | 3,205 | 6,434 | 2.01 | 6,127 | 1.73 |
| Bihar | 10,743 | 74,130 | 6.90 | 735 | 0.06 |
| Goa | 67 | 126 | 1.88 | 813 | 11.00 |
| Gujrat | 10,292 | 146,528 | 14.24 | 1,710 | 0.15 |
| Haryana | 3,711 | 233,376 | 62.89 | 21 | 0.01 |
| Himachal Pradesh | 1,010 | 2,189 | 2.17 | 12 | 0.01 |
| Jammu & Kashmir | 1,014 | 3,717 | 3.67 | 23 | 0.02 |
| Karnataka | 12,321 | 73,856 | 5.99 | 9,227 | 0.68 |
| Kerala | 1,796 | 7,708 | 4.29 | 5,121 | 2.59 |
| Madhya Pradesh | 22,111 | 195,108 | 8.82 | 407 | 0.02 |
| Maharastra | 20,925 | 110,763 | 5.29 | 3,153 | 0.14 |
| Manipur | 175 | 357 | 2.04 | 845 | 4.38 |
| Orissa | 5,296 | 12,989 | 2.45 | 1,551 | 0.27 |
| Punjab | 4,033 | 332,675 | 82.49 | 21 | 0.00 |
| Rajasthan | 20,971 | 175,288 | 8.36 | 32 | 0.00 |
| Tamil Nadu | 7,474 | 85,062 | 11.38 | 12,399 | 1.50 |
| Uttar Pradesh | 17,986 | 434,412 | 24.15 | 255 | 0.01 |
| West Bengal | 5,656 | 16,121 | 2.85 | 17,396 | 2.79 |
| Other states* | 2,123 | 77 | 0.04 | 2,237 | 0.96 |
| Union Territories | 140 | 4,568 | 32.63 | 281 | 1.82 |
| **Total** | **165,509** | **2,015,551** | **12.18** | **65,929** | **0.40** |

## DISCUSSION

**Theodor FRIEDRICH**

*Are you using the OECD methods for your national tests too? Or are there very few OECD tests being used? I'm not too clear about the situation.*

**Gajendra SINGH**

*Yes we are still following mainly the OECD tests. The system is that, before a tractor goes to the market, it has to be tested and certified and accepted. Then, annually, a sample is picked randomly and checked. That interval increases later on - initially it's every year, but I think later on it could be two years, even increasing to three or four years. But it is basically OECD tests.*

**Yoshisuke KISHIDA**

*I have a question about - in India what kind of safety regulations do you have now for tractors? And another question is: what kind of new regulations are forthcoming related to emission control?*

**Gajendra SINGH**

*See in India life it is still very cheap, so we don't have very stringent safety regulations. I think the labour cost per day is about a dollar: one US dollar for one day of labour. Now from that point of view, I think we can very easily link the cost of a human labourer to the price that is attached to him. So these issues are being discussed. You know we don't yet require R.O.P.S. (Role Over Protective System) on tractors in India. It's not a requirement, although it's a very simple safety feature which can really protect and reduce injury dramatically. So now we are starting to discuss safety, I have tried my best for the last three years, and I think they have accepted in principle simple things like R.O.P.S. on the tractors. So safety hasn't been a very major factor. In India the hydraulics, the transmission, etc. will be of the highest quality, but human engineering, the ergonomics part - which relates to the safety - is really low priority. And that's where the cost cutting is. But I think as the economic development moves forward these issues will become more important. So at least they are being discussed, but they will come in only very slowly.*

**Yoshisuke KISHIDA**

*My second question was related to the regulations on emission control from diesel engines.*

**Gajendra SINGH**

*Yes I think this is an issue where we are starting with the automobile industry first, in major cities like Delhi and Bombay. Delhi is I think the fourth most polluted city in the world. I think the credit of first place goes to Mexico City, but fourth is not very far behind. And then Bombay is also coming very close in that list. So emission control is being applied to automobile sector first. And in India now any vehicle which is more than 20 years old is taken off the road in the major cities, is not allowed to be on the road. Irrespective of its condition. So it has to come into the automobile sector first, and then I think the tractors will also come in following that.*

**Giuseppe Pellizzi**

*Thank you very much Mr. Singh for your excellent report. However this is only a preliminary report, a sort of introduction to a subject that will be more deply discussed during our meeting of the next year. Thank you very much to all of you for your cooperation and best wishes for your trip to home. We will meet on 14$^{th}$-15$^{th}$ November 1999.*

## LIST OF PARTICIPANTS

| | |
|---|---|
| Hugo Cetrangolo– Full Member | Argentina |
| Malcolm Mckay– Full Member | Australia |
| Rainer Ramharter– Full Member | Austria |
| Johann Schrottmaier | Austria BLT |
| Pierre Abeels– Full Member | Belgium |
| Gastão Moraes Da Silveira | Brasil (CMAA-IAC) |
| Pavel Kic– Full Member | Czech Republic |
| A. Mahmoud El Hossary– Full Member | Egypt |
| Francis Sevila– Full Member | France |
| Bernard Cheze– Full Member | France |
| Philippe Marchal (standing in for Gérard Jacquin) | France |
| Emmanuel Hugo | France (CEMAGREF) |
| Jean Marie Debois | France (OECD) |
| Hermann Heege – Key-note Speaker | Germany |
| Karl Th. Renius – Full Member | Germany |
| Jürgen Zaske – Full Member | Germany |
| H.D. Kutzbach – Full Member | Germany |
| Hermann Auernhammer – Full Member | Germany |
| H.H. Bertram – Key-note Speaker | Germany (DLG) |
| Lothar Fischer – Full Member | Germany (J.Deere) |
| Helmut Weiste – Key-note Speaker | Germany (Kverneland-Accord) |
| Zoltan Sibalszky | Hungary |
| Gajendra Singh – Full Member | India |
| Uri M. Peiper – Full Member | Israel |
| Luigi Cavazza – Key-note Speaker | Italy |
| Carlo Ambrogi – Full Member | Italy |
| Enzo Manfredi – Full Member | Italy |
| Pietro Piccarolo – Full Member | Italy |
| Eugenio Todeschini – Full Member | Italy |
| Gualtiero Baraldi – Associate Member | Italy |
| Luigi Bodria – Associate Member | Italy |
| Giuseppe Pellizzi – President | Italy |
| Marco Fiala – Technical Secretary | Italy |

| | |
|---|---|
| Roberto Oberti - Technical Secretary | Italy |
| Giorgio Castelli – Associate Member | Italy |
| Gennaro Giametta – Associate Member | Italy |
| Franco Sangiorgi – Associate Member | Italy |
| Paolo Celli – Key-note Speaker | Italy (Celli) |
| Sandro Liberatori – Key-note Speaker | Italy (CONAMA) |
| Theodor Friedrich (standing in for Lawrence Clarke) | Italy (FAO) |
| Shigeki Kida – Full Member | Japan |
| Yoshisuke Kishida – Full Member | Japan |
| Osamu Kitani – Full Member | Japan |
| Yoshinari Yamashita (standing in for Yasuo Yamamoto) | Japan |
| Toyoshi Miyamaga | Japan |
| Manabu Yasuhara | Japan - FAO |
| Hiroyuki Takahashi – Key-note Speaker | Japan (Brain) |
| Toshiyuki Yotsumoto | Japan (KUBOTA) |
| Bassam A. Snobar – Full Member | Jordan |
| Branislav Rajic | Jugoslavia |
| Jovanovic Dragan | Jugoslavia |
| Chang Joo Chung – Full Member | Korea |
| Arturo Lara Lopez – Full Member | Mexico |
| El Hassan Bourarach – Key-note Speaker | Morocco |
| Gavin Wall – Full Member | New Zealand |
| Egil Berge | Norway |
| Ghazanfar Abbas – Associate Member | Pakistan |
| Jan Pawlak – Full Member | Poland |
| Oleg S. Marchenko – Full Member | Russia |
| Leonid P. Kormanovsky – Full Member | Russia |
| Jaime Ortiz-Cañavate – Full Member | Spain |
| Walter Meier | Switzerland (FAT) |
| Chak Chakkaphak – Full Member | Thailand |
| M. Ali Ben Abdallah | Tunisia |
| Tim Chamen – Key-note Speaker | U.K. |
| Nigel Warner – Full Member | U.K. |

| | |
|---|---|
| Derek H. Sutton – Full Member | U.K. |
| Michael R. Hodge – Key-note Speaker | U.K. (Simba International) |
| Wayne Le Pori (standing in for Bill Stout) | U.S.A. |
| Richard Hegg – Full Member | U.S.A. |

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*Key-note speakers:*



***Discussion***

## SESSION 2

**Official testing and evaluation of tractors and implements: a tool to assist farmers in assessing performance, safety and environmental factors**



***Discussion***

## SESSION 3

### Tractor industry in India