

Standardized Tractor Performance Testing What It Is—and Isn't



Tractor testing is conducted in a lab and on a concrete test track. Instrumented load carts are used to simulate loads and drafts of pulled implements.

Your biggest machinery investment

The Canadian Farm and Industrial Equipment Institute reports that 3,271 new 2WD tractors over 100 hp were sold in Canada in 1994. That's over \$281 million worth of tractors, assuming an average value of \$86,000 each.

Spending that kind of money makes it worthwhile to do some serious research before taking the plunge. We've put together a few tips and sources of information you can consider before making a buying decision.

Start with the Basics- Tractor Test Results

There are tools available in the form of OECD Tractor Reports to help farmers get unbiased performance information on tractors before making a pur-

chase decision. The Nebraska Tractor Testing Laboratory summarizes the results into a convenient booklet form. More detailed single reports on specific models are also available.

What do the results include?

The most important thing farmers should know about OECD tractor test results is that they are fact based.

You won't find any subjective evaluation. The reports won't tell you if the cab is comfortable or if the controls are easy to use. That's because the intent of the test program is to allow an objective comparison between tractors, given the considerable number of variables at work.

The reports will give you a lot of numbers—numbers that define horsepower, torque, fuel consump-

A Co-operative Program Between



tion, hydraulic pump pressures, lifting capacities, heights and angles of the three-point hitch, drawbar power—the list goes on.

There are different levels of tests. Some are optional, but the basic test procedure is compulsory, and includes four sections in the test report:

- **Specifications.** Test engineers verify measurements and specifications to make sure everything is consistent with the manufacturer's specifications.
- **Test Conditions.** Engineers record the exact test conditions of the test tractor to ensure that conditions meet the requirements of the test procedure.
- **Compulsory tests.** Engineers record the performance of the tractor at the main power takeoff, the power lift and hydraulic pump, and the drawbar. Included in the drawbar tests and PTO tests are fuel consumption measurements.
- **Graphs.** Numerous graphs available in the full versions of OECD reports give readers a look at equivalent crankshaft torque, PTO power, and PTO fuel consumption.

How to interpret results

Most farmers are interested in the basics—that is PTO performance, fuel consumption, power lift and hydraulic pump performance, and drawbar power—so that's what we'll focus on.

PTO Performance

PTO performance is measured at several different power levels and speeds, but for comparison purposes between tractors, the data most farmers are interested in is maximum power at rated engine speed. This is the highest power level that the tractor can sustain over a long term, and is measured in horsepower or its metric equivalent, kilowatts.

It's worthwhile to note that newer tractors usually have an operating range which includes maximum power at a speed lower than rated. Also, with modern high torque/constant power engines, the power at rated PTO speed is usually very similar to the power at the rated engine speed.

Drawbar Performance

It's important to note that drawbar tests are conducted on concrete or asphalt test tracks, so the num-

bers recorded in the test reports are not exactly the numbers you might get in field conditions. The reason for the concrete test track is to give consistent results for tractors tested at different times. It would be impossible to maintain consistent soil conditions for every test in a field situation.

Like PTO performance, drawbar performance is measured at different rates of pull and in different gears. Power measured at 75 per cent of pull at maximum power is a reasonable reflection of performance during typical heavy field work. At 75 per cent of pull at maximum power you will still have some reserve for heavy spots in the field.

Fuel Consumption

Fuel consumption (fuel consumed over a given time) is listed, but is not a measure of efficiency. Instead, look at specific fuel consumption as a measure of power for a given amount of fuel. It's measured in horsepower-hours per gallon of fuel, expressed as Hp•hr/gal (kilowatt hours per litre expressed as kW•h/l). The higher the numbers, the more work is being done with a given amount of fuel. Again, keep in mind that specific fuel consumption measured at maximum power can't be maintained in the field due to variations in soil, terrain, and other factors.

Power Lift

The most important measurement for farmers here is the force available, an indication of lifting power (note that lifting power is not the same as the maximum load that can be carried safely). Although several measurements are taken, the one most practical to use is the lowest corrected force through the full range measurement. It will give you an idea of the minimum force available throughout the entire range of movement for the three-point hitch. Nebraska summary reports publish only the lowest corrected force.

Noise

Noise is measured in two ways for OECD tests: at the operator's ear and from a bystander position, and is measured in decibels [db(A)].

Understanding noise measurement is a tricky business for the uninitiated. Mathematically speaking, an increase or decrease of 6 dB(A) is a doubling (or

halving) of sound pressure — what the human ear interprets as noise or sound. But to the human ear, a noise that sounds twice (or half) as loud is actually measured at 10 dB(A). So when comparing noise figures, remember that it takes a reduction of 10 dB(A) before the human ear will perceive the noise as being half as loud.

What you won't find

OECD testing standards are also in place for Roll Over Protective Structures (ROPS). These tests are conducted on a pass/fail basis. If a tractor is on the market, it has most likely passed the ROPS test.

Glossary of Terms

Compulsory Tests: These tests represent the minimum tests required by the standard. Manufacturers can choose to have additional, optional standardized tests conducted at their discretion. Optional test results are not required to be made public.

Decibels [dB(A)]: A nonlinear unit of measurement for noise. The (A) identifies the type of filter used. Measurements can also be expressed as dB(B) or dB(C). A reduction in noise of 10 dB(A) reduces by about half the noise perceived by the human ear.

Dynamometer: A loading device used to test tractor performance.

Lowest Corrected Force: This is the minimum force you can expect throughout the entire range of movement for the three-point hitch.

OECD: Organization for Economic Cooperation and Development.

Rated Engine Speed: The speed at which the engine manufacturer says the engine can function indefinitely.

ROPS: Roll Over Protective Structure

SAE: Society of Automotive Engineers

Specific Fuel Consumption: Expressed as Hp • hr/gal (Imperial) or kW•h/l (Metric), it is a measurement of the power produced over a given time period per given volume of fuel. For comparison purposes, it is a more appropriate measure of fuel consumption than gal/hr (l/ha). The higher the number, the more work is being done with a given amount of fuel.

Have tractors improved?

We thought it would be interesting to take a look at the two most important performance features of tractors and compare those of years ago to today's models. Below is a table that averages the ratings for six of the most common 100 hp tractors sold in Canada.

Remember that cutting noise by 10 decibels reduces by half the noise perceived by the human ear. That's because noise is measured on a logarithmic scale—the measurements are not linear.

	Average 1975	Average 1995	Per Cent Change 1975 - 1995
Specific Fuel Consumption @ Rated rpm (hp hours/gal)	14.93	17.40	16.5
			Decrease in Noise
Noise at Operator's Ear [dB(A)]	88.36	78.4	9.96 or 68.23%



Specialized instrumentation is used to measure fuel consumption during a test.

Three Types of Reports

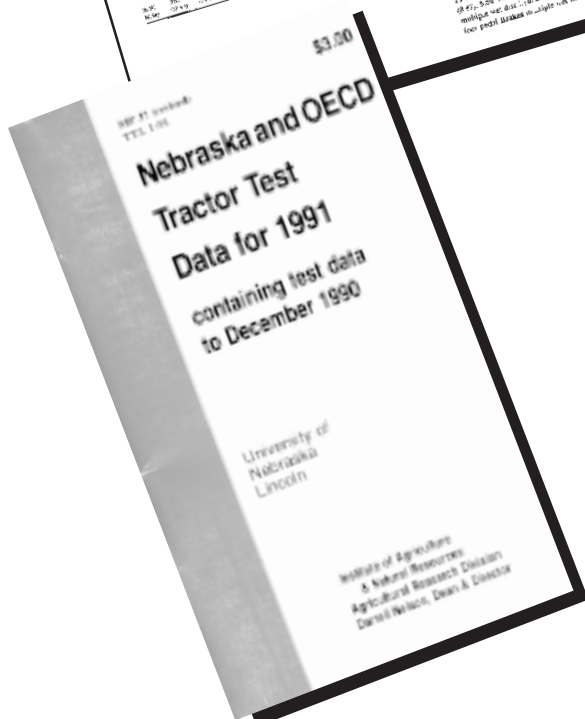
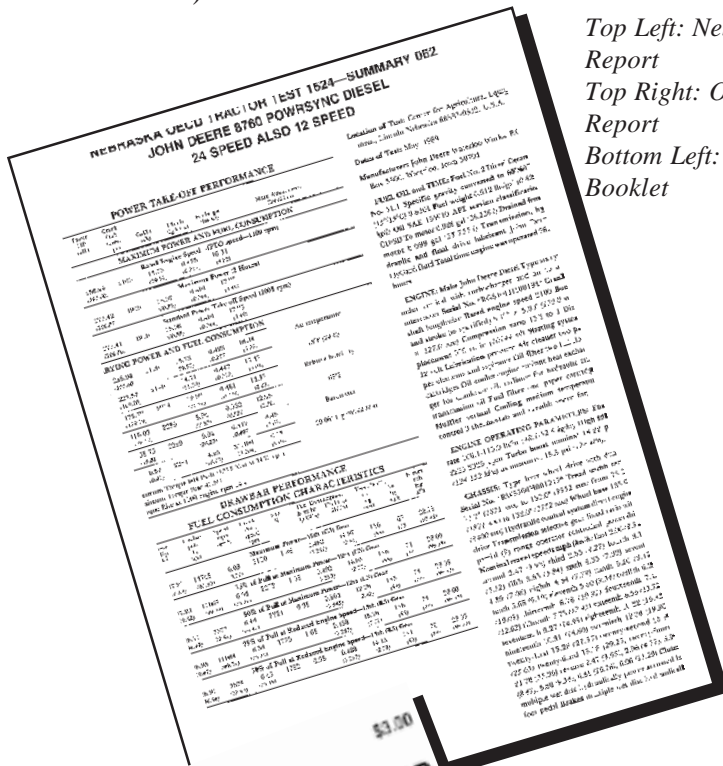
The Nebraska test station publishes a full report on each tractor model tested (usually about four pages) as well as a summary of tests of all tractors for which manufacturers have been issued a sales permit for a given year in the state of Nebraska. The full reports stipulate whether the test procedure used was OECD or SAE. The summary booklets combine both SAE and OECD results (in separate sections) into a booklet form.

The full OECD reports are the most comprehensive and contain the most information. These reports are normally available from the test station located in the country of manufacture for a particular tractor (Nebraska does not supply full versions of OECD reports). For tractors manufactured in Canada, reports can be ordered from PAMI. See the back of this report for addresses.

Top Left: Nebraska Test, Full Report

Top Right: OECD Test, Full Report

Bottom Left: Nebraska Summary Booklet



Where to get results

Full versions of OECD reports are comprehensive and contain a lot of complex information that requires interpretation. Full versions of Nebraska test reports offer most of the performance information, but not all of the same specifications.

The easiest to read data comes in the form of the Nebraska and OECD Tractor Test Data summaries. They summarize the important information of all tractors which have been issued a sales permit for the state of Nebraska into a handy little booklet for farm use, allowing farmers to compare results across all brands tested. There is a small charge (\$3.50 US for the 1995 version), or you can subscribe for \$14.00 US per year for the full Nebraska reports (plus mailing costs).

They can be ordered from the Tractor Testing Laboratory, Department of Biological Systems Engineering, University of Nebraska-Lincoln, P.O. Box 830832, Lincoln, NE 68583-0832.

Compare with Care



Comparing Test Procedures

The tractor testing business is a little messy and can be confusing for the uninitiated.

That's because the requirements vary between tractor testing bodies. For tractors sold in Nebraska, manufacturer's can use either the SAE (Society of Automotive Engineers) test procedure or the OECD test procedure—either is acceptable. For tractors sold to other OECD countries, only the OECD test procedure is acceptable.

But in some specific tests, differences between test procedures can produce data that is more favourable to the manufacturer. This is important when comparing tractors that have been tested using two different procedures.

The Nebraska test summaries divide the tractors into the two categories, making comparison somewhat easier. However, the tractors you want to compare may fall into different categories, which means you may not be comparing apples to apples in some specific tests. The good news is that more tractors are being tested only to the OECD test procedure as time goes by.

Comparing Results

The OECD test procedure has been agreed to by all the OECD member countries as an accurate and consistent way to reflect results.

However, the results provided in the reports can be complex, and require some interpretation.

That's partly because variables involved in such sophisticated testing, such as weather and ballasting conditions, affect the operational variables of fuels, lubricants, and engines.

Other factors also come into play. When comparing drawbar power, remember that it has a relative relationship to drawbar pull and travel speed. A tractor tested with maximum permissible ballast will usually develop maximum power at a much lower speed and higher pull than one tested without ballast. You must consider all three figures together—power, speed, and pull—to accurately compare drawbar performance of different tractors.

When comparing power output and fuel efficiency, use the data recorded at 85 per cent of maximum PTO power and 75 per cent of pull at maximum drawbar power. These figures more accurately reflect day-to-day tractor use. Fuel efficiency ratings under *maximum* PTO power or drawbar power are not sustainable over long periods in the field.

A few other basics to keep in mind are:

- Tests are conducted on ballasted and unballasted tractors. Make sure you're comparing ballasted results to ballasted results, and unballasted results to unballasted results.
- Note the basic specifications of each tractor, such as weight as tested, engine displacement, transmission type, and rated rpm.

All things considered, the facts presented in the test reports are a valuable resource for buyers who want to compare specifications from one tractor to another. And perhaps the best feature is that farmers have access to independently verified specifications and results.

Who, When, Why and Where?

Who does the testing?

The OECD (Organization for Economic Cooperation and Development) is an assembly of twenty-five member countries that offers governments the chance to talk with each other about economic and social policy.

Each OECD member country has a designated tractor testing authority for tractors originating from that country. Non-member countries can also obtain OECD membership.

In Canada the designated authority is PAMI, while in the US the Equipment Manufacturer's Institute holds that position. They in turn subcontract the Nebraska Tractor Testing Laboratory at the University of Nebraska-Lincoln. Various member countries elsewhere operate their own test centres.

Reports from each country are approved through a central processing office in Paris, France, so data from each tractor tested is as consistent as possible. This is important to make comparisons between brands.

More Information on Tractors

Evaluation Report 707- Comparison Tests on Tire Pressure Gauges, available from PAMI or AFMRC
Research Update 726- Five Tips for Efficient Tractor Operation, available from PAMI

Research Update 725- Ballasting for Performance, available from PAMI

Tracks versus Wheels- Which is for You?, available from AFMRC see information box on last page of this report for contact information.

Tractor Performance- What's Best for You?, available from AFMRC

When and why are tests conducted?

Testing is conducted at the discretion of the manufacturer. Sometimes there is a mandatory requirement within some jurisdictions that require OECD (or equivalent) testing as a condition of selling a model. Nebraska is the only jurisdiction in North America that currently has this requirement.

In other instances, the market demands this information. In Europe, many farmers will not make a buying decision without first consulting the OECD test reports. Therefore manufacturers are obligated to provide this information as a marketing requirement, even if it is not a mandatory requirement.

Where is it done?

In Canada, the PAMI station in Portage la Prairie conducts tests to OECD specifications. Tests must be directed by authorized personnel from the designated test station for the country of origin.

Northern Tractor Resource Centre, Montana State University, P.O. Box 7751, 2 Cowan Drive Havre, MT 59501 Phone: (406) 265-3700 FAX: (406) 265-3777

Air Cleaner Servicing, Coolant Test Kit information, available from Donaldson Company Inc., Box 1299, 1400 West 94th Street, Minneapolis, Minnesota 55440 Phone: (612) 887-3131

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