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Eight tractors in the 35-45 h.p. class. Part 1

W F. Baillie
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TRACTOR TESTS

EIGHT TRACTORS IN THE 35-45 HP CLASS

Summary report of tests on tractors in the 35-45 h.p. class by the Australian Tractor Testing Committee, based on Tractor Tests Nos. 38 to 45.

by
W. F. BAILLIE and G. H. VASEY
Department of Agricultural Engineering
University of Melbourne
April 1967

PART 1

General description
The eight models included in this series practically cover the small tractor field in Australia. The International A414 is substantially Australian made; the others are imported in various stages of “knocked-down” condition and re-assembled with some local content, usually no more than wheel and tyre equipment, batteries, and spark arresters. Ford, Massey-Ferguson, David Brown and Nuffield are of U.K. origin; Fiat is from Italy; John Deere from the U.S.A.

All except the John Deere 1010 RS are general purpose farm tractors; the John Deere is a special purpose, high-clearance offset tractor sold mainly in the sugar cane areas for inter-row cultivation. The Fiat and the David Brown can also be supplied as row crop models. On each of these models the final drive housing can be refitted to give a high-arched rear axle which, with suitable modification of the front axle, gives the tractor a high clearance without affecting the travel speeds in the various gears.

Three-point linkage and a conventional fixed and swinging drawbar are standard equipment on all models except the two Fords where the drawbar fitting is optional equipment.

Weight
The weights of the various models show considerable differences, both in the standard weight condition, that is as usually sold, and in the maximum weight condition as recommended for normal field use.

Since weight proves to be a matter of some importance in matching a tractor to the job and to existing implements, Table 1 separates the models into approximately
Nuffield, as will be seen from the table, may be regarded as being in a heavier class than the others. The David Brown and the others.

Straight drawbar work is directly related to its weight, the David Brown and the others.

A three-point linkage has been provided, unless otherwise ordered, giving the alternative standard weights shown.

Primarily designed as a drawbar tractor, it is designed primarily as a drawbar tractor with mounted implements.

All but Massey-Ferguson choose to "build-in" some weight to cover the possibility that the tractor may be used, even in its standard weight condition, for general towing work. Since in 39 and 44 the drawbar is offered only as optional equipment, it may be inferred that Ford rather envisages their tractors being used primarily as light weights with mounted implements. Massey-Ferguson offer alternative heavy wheels which, if selected, bring this version of the M-F 135 into line with the others on a standard weight close to the average of 4,000 lb.

David Brown (43) also offer alternative light or heavy wheels; further, it is David Brown's practice to supply their tractors with 75 per cent. water ballast in all tyres unless otherwise ordered, giving the alternative standard weights shown.

The Nuffield 10/42 (45) is exceptional in that it is designed primarily as a drawbar tractor, though a three-point linkage has been added to enable it to be used also with mounted implements.

Drawbar tests are carried out on a level tarmac road. For the purpose of defining Maximum Drawbar HP the gear is chosen that gives a road speed nearest to 4 mph at full load, rated engine speed. For the main drawbar tests added ballast is permitted up to the maximum recommended by the manufacturer for normal agricultural use.

At the end of the tests a check is made of pto power to see whether any significant gain or loss of power has taken place between the run-in and the end of the tests, usually a period of 35-40 hours of test running. The engine and the transmission are then partly dismantled and examined for signs of undue wear or damage.

The manufacturer is represented at the tests by professional engineer observers and by other technical staff, such as drivers and mechanics.

All the results shown in test reports are obtained from observed data; no allowances or corrections are applied. Though not having the right to withhold or suppress the report, or to vary the test results, the manufacturer is given the opportunity to see the report before printing, and to correct any errors of fact or misplaced emphasis. As far as possible, the report is confined to measurable features of the tractor and its performance.

The present intention is to continue to bring tractors in for test in series of comparable models in accordance with the several classes of tractor as defined in Australian Standard D10-1967 'Classification of Wheeled Tractors for Agricultural Purposes' issued by the Standards Association of Australia.

Copies of the full Technical Reports and the Abridged Reports upon which this summary report is based may be obtained from the Department of Primary Industry, 301 Flinders Lane, Melbourne or from the State Departments of Agriculture.

Table 1.—Standard and maximum weights (lb.)

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Standard Weight, lb.</th>
<th>Max. recommended Weight, lb.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>4,170</td>
<td>5,470</td>
</tr>
<tr>
<td>39</td>
<td>4,000</td>
<td>5,350</td>
</tr>
<tr>
<td>40</td>
<td>3,660</td>
<td>5,190</td>
</tr>
<tr>
<td>41</td>
<td>3,360 (a)</td>
<td>4,990</td>
</tr>
<tr>
<td>42</td>
<td>3,900</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>4,310 (a)</td>
<td>6,300</td>
</tr>
<tr>
<td>44</td>
<td>4,040 (a)</td>
<td>6,170</td>
</tr>
<tr>
<td>45</td>
<td>4,550</td>
<td>6,970</td>
</tr>
</tbody>
</table>

(a) Light wheels. (b) Heavy wheels. (c) Light wheels and water ballast as usually sold. (d) Heavy wheels and water ballast as usually sold.

comparable weights around 3,500, 4,000, 4,500 lb. and so on.

Comparing with the others, the light wheel version of the M-F 135 (Test No. 41) at 3,360 lb. standard weight, may be thought of as relying entirely on "weight transfer" from suitably matched mounted implements to achieve traction.

Since the ability of a tractor to perform normal agricultural use.

Tests are also done to measure the power available at the pto and through the belt pulley at the engine speeds required to give British Standard (B.S.) pto speed and B.S. belt linear speed respectively.

The main tests for power output are done on the engine itself directed coupled to a dynamometer. All auxiliaries needed for the normal operation of the engine are fitted and functioning. The engine runs under the control of the governor, which is set so that full power is obtained precisely at rated speed. Included in the pre-test checks is a check of the fuel pump calibration to ensure that it is within the manufacturer's specified limits.

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EXPLANATION OF TEST PROCEDURES

Australian Tractor Tests are carried out under procedures that are basically similar to those used at the University of Nebraska, U.S.A., and the National Institute of Agricultural Engineering, U.K. However, in Australia the test tractor is chosen at random from stock, it receives no special treatment or preparation for test apart from the dealer's usual pre-delivery checks which are done by the Company's representatives at the Testing Station. A standard 12 hr run-in is given.

The main tests for power output are done on the engine itself directed coupled to a dynamometer. All auxiliaries needed for the normal operation of the engine are fitted and functioning. The engine runs under the control of the governor, which is set so that full power is obtained precisely at rated speed. Included in the pre-test checks is a check of the fuel pump calibration to ensure that it is within the manufacturer's specified limits.

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With each of the models it would be necessary to add ballast up to recommended maximum in order to achieve the full drawbar performance obtained in the tests; this affects principally the pulls obtainable in the lower gears where traction is limited by wheelslip, that is, by weight.

It is of interest to note that Massey-Ferguson offer an optional attachment called a “Pressure Control Hitch” by means of which the three-point linkage can be used to transfer weight from the drawbar of a trailer or trailed implement. For the light wheeled standard version this could transfer sufficient further weight to the rear wheels to give the same drawbar performance as for the fully ballasted model that was tested.

Engine power

From the Performance Summaries in the test reports the eight models in the series had the power outputs shown in Table 2 in which the manufacturer’s rating is shown also for comparison.

### Table 2.—Test power outputs and manufacturer’s ratings

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Rated Speed r.p.m.</th>
<th>Full shaft power (h.p.)</th>
<th>Manufacturer’s rating (h.p.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>2,000</td>
<td>39-0</td>
<td>40 (a)</td>
</tr>
<tr>
<td>39</td>
<td>2,000</td>
<td>34-1</td>
<td>37 (a)</td>
</tr>
<tr>
<td>40</td>
<td>2,500</td>
<td>42-6</td>
<td>45 (a)</td>
</tr>
<tr>
<td>41</td>
<td>2,250</td>
<td>38-2</td>
<td>45-5 (b)</td>
</tr>
<tr>
<td>42</td>
<td>2,500</td>
<td>38-7</td>
<td>36 (c)</td>
</tr>
<tr>
<td>43</td>
<td>2,200</td>
<td>46-3</td>
<td>46-0 (b)</td>
</tr>
<tr>
<td>44</td>
<td>2,000</td>
<td>41-6</td>
<td>46 (a)</td>
</tr>
<tr>
<td>45</td>
<td>2,000</td>
<td>42-5</td>
<td>44-5 (a)</td>
</tr>
</tbody>
</table>

(a) Bare engine.  (b) Fully equipped engine.  (c) P.T.O.

The only model of the eight to require no special interpretation is the David Brown (43). The advertised value of 46 hp refers to a fully equipped engine; the randomly chosen sample confirmed the claimed value by a small margin.

For the others, there are noticeable differences between some of the test values and the corresponding manufacturer’s ratings. These are to be explained in a variety of ways as follows:

International, Ford, Fiat and Nuffield advertise the power output of a bare engine, that is to say, the power that the engine would deliver if stripped of all auxiliaries such as fan, water pump, air cleaner, muffler and generator. These auxiliaries normally consume about 3-4 hp in this size of engine.

It must also be kept in mind that all engines off a production line do not give exactly the same power output; there might be a range of variation in power output of 10 per cent. or more.

It will be seen therefore that when suitable reductions have been made in the bare engine power outputs claimed by the manufacturers, the test values (for fully equipped engines) for Nos. 38, 39, 40, 44, 45 come within the range that could be expected. For Nos. 39, 40, 44 and 45 confirmation of this was found elsewhere in the manufacturer’s technical data where additional ratings were found for fully equipped engines.

John Deere (42) use only the Nebraska test values in advertising; these are for power output at the PTO not at the engine crankshaft. The test output of 38.7 engine shaft hp is not inconsistent with the advertised 36 pto hp.

In test No. 41, though it was agreed by the company’s technical observers that the test tractor was fully up to specification and was in no way exceptional, the test value of 38.7 shaft hp could not be reconciled with the value of 45.5 hp quoted in the Operator Instruction Book supplied with the tractor. It is thought that the claimed value, which is for a fully equipped engine, was obtained from English tests, possibly on a specially selected tractor and one in which the fuel pump also was set above the fuel delivery specified for the

This report is based on the following Australian Tractor Tests:

38 — INTERNATIONAL A414
39 — FORD DEXTA 2000
40 — FIAT 415
41 — MASSEY-FERGUSON 135
42 — JOHN DEERE 1010 RS
43 — DAVID BROWN 880 A
44 — FORD SUPER DEXTA 3000
45 — NUFFIELD 10/42
model. It can be assumed, however, that the test value is typical of the model as sold in Australia.

Some further comments are necessary before a complete comparison of power outputs can be made within this class which, by definition in AS D10, covers the range 35–45 hp at the pto.

The Fiat (40) and the John Deere (42) both show rated engine speeds of 2,500 rpm. Consideration of all the performance data (recommended speeds for pto and belt work, road speeds, fuel consumption and so on), set out in the graphs and tables of the test reports, leads to the conclusion that a normal operating speed somewhat less than this nominal rated speed is envisaged by these two manufacturers. Thus at 2,160 rpm, where the Fiat gives its standard pto speed, the engine power is about 39 shaft hp; on the John Deere at 1,900 rpm, where there is a stop provided on the governor control lever and where standard pto and belt speeds are obtained, the power output is about 34 shaft hp. The higher speeds, obtainable by the over-riding foot throttle on the Fiat, and by over-riding the stop on the governor control lever of the John Deere, may thus be regarded as reserve speeds for road work or for manoeuvring at the ends of rows, situations in which full power is not required.

Taking all this into account, the eight models divide themselves into two subgroups for power output, with the David Brown (43), Nuffield (45) and Ford 3,000 (44) in the higher bracket.

This distinction would be most noticed in full load drawbar working at normal rated speeds.

Though not an infallible guide, some indication of and support for the above grouping can be obtained from a consideration of the cubic capacities of the engines. Thus, No. 38 has 154 cubic inches, No. 39 has 155, No. 40 has 139, No. 41 has 153 and No. 42 has 145, while for the larger group No. 43 has 164, No. 44 has 175, and No. 45 has 173 cubic inches.

**Power at PTO and belt**

Important further points of comparison are the engine speeds at which British Standard pto speed (540 rev. per min.) and British Standard belt linear speed (3,100 feet per min.) are obtained. Implement manufacturers tend to design their machines for input speeds corresponding to these standards. If the engine speeds at which these occur are less than rated engine speed, then, at these lower engine speeds there will be correspondingly less power available for distribution through the tractor, and so to the pto or belt.

Table 3 sets out details of pto and belt speeds and powers for the eight models.

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Engine rated speed</th>
<th>Engine speed for 540 p.to. r.p.m.</th>
<th>P.T.O. power At 540 r.p.m.</th>
<th>Engine speed for 3,100 belt f.p.m.</th>
<th>Belt power at 3,100 belt f.p.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>2,000</td>
<td>2,000</td>
<td>36</td>
<td>36</td>
<td>2,000</td>
</tr>
<tr>
<td>39</td>
<td>2,000</td>
<td>1,800</td>
<td>31</td>
<td>36</td>
<td>2,000</td>
</tr>
<tr>
<td>40</td>
<td>2,500</td>
<td>2,160</td>
<td>30</td>
<td>40</td>
<td>2,180</td>
</tr>
<tr>
<td>41</td>
<td>2,250</td>
<td>1,685</td>
<td>36</td>
<td>32</td>
<td>2,250</td>
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<tr>
<td>42</td>
<td>2,500</td>
<td>1,900</td>
<td>32</td>
<td>35</td>
<td>1,900</td>
</tr>
<tr>
<td>43</td>
<td>2,200</td>
<td>1,800</td>
<td>37</td>
<td>42</td>
<td>2,000</td>
</tr>
<tr>
<td>44</td>
<td>2,000</td>
<td>1,600</td>
<td>35</td>
<td>39</td>
<td>35</td>
</tr>
<tr>
<td>45</td>
<td>2,000</td>
<td>1,400</td>
<td>30</td>
<td>39</td>
<td>1,800</td>
</tr>
</tbody>
</table>

Only the International A414 (38) has the full power of the engine available at the pto and belt outlets at their standard speeds. (The differences of about 3 hp between engine and pto, and again the difference between pto and belt hp are the to-be-expected normal losses in the drives). Of the others, Nos. 39, 43 and 44, though not having pto speed right on rated engine speed, conform with B.S. 1945:1964, which specifies that the engine speed for pto work should be not less than 80 per cent. rated speed; the remainder (Nos. 40, 41, 42, 45) are outside this limit.

The power at the pto for 540 pto rpm should be carefully noted if it is proposed to use the tractor with pto driven implements. It will be seen that for pto work the sub-grouping mentioned earlier would have to be reconsidered. The top bracket for this purpose would include Nos. 38, 40, 43 and 44.

Readers may also find some interest in making a similar comparison of belt power output.

—TO BE CONTINUED