Australian tractor tests : no. 31

G. H. Vasey

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THIS Report is taken from the full Technical Report No. 31 of this test; test results are shown here in briefer form: fuller explanations are added. Values quoted may be rounded out to two instead of three significant figures; to this extent the values may differ slightly but not significantly from those shown in the Technical Report. Graphs of belt test performance, shown in the Technical Report, are not shown here. The Technical Report is not available in large numbers, but it may be seen at, and copies of this farmers' report may be had from, the offices of the State Departments of Agriculture, the Bureau of Sugar Experiment Stations (Queensland), and the Commonwealth Department of Primary Industry.

1. THE TESTS

(1) After twelve hours of running-in two types of tests were carried out, in order to measure the performance of the engine, as measured by the power in the belt driven by the belt pulley, and the performance of the tractor as a whole, as measured by drawbar pull, tractor speed, wheel slip, and drawbar horse-power (d.b.h.p.), with the tractor running on a bitumen test track.

The main results of these tests are given in Sections 2, 3, and 4. Other measurements and observations were made of various features of the tractor; these are given in Section 5.

(2) Fuel Settings.—The engine of this tractor has only one fuel setting, at which all the tests were carried out.

(3) Governor Control.—The engine was under the control of the governor set to give full throttle, and so maximum power at rated engine speed. (See note 2, paragraph 5, Other Observations, below).

(4) Fuel.—Distillate, Diesel Index 66, Specific Gravity 0.82; weight per Imperial gallon 8.17 lb.

(5) Specification.—Engine No. AD/30H 2411. For a brief specification of this tractor see Section 6 at the end of this report.

The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement, the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: C/o Department of Primary Industry, 301 Flinders Lane, Melbourne.
2. SUMMARY OF POWER OUTPUT

Table A

<table>
<thead>
<tr>
<th>At the Belt</th>
<th>At the Drawbar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated engine speed, r.p.m.</td>
<td>2,200</td>
</tr>
<tr>
<td>Corrected maximum power(a)</td>
<td>34.6</td>
</tr>
<tr>
<td>Rated power (b)</td>
<td>29½(81)</td>
</tr>
</tbody>
</table>

Note.—Letters in brackets refer to explanatory footnotes.

3. BELT TESTS

The belt tests show the power (belt horse-power, b.h.p.) that the tractor may be expected to deliver when driving a machine by the belt.

Table B.—Belt Test Results

<table>
<thead>
<tr>
<th>Engine Speed</th>
<th>Fuel Gall./hr. (c)</th>
<th>lb./b.h.p. hr.</th>
<th>DBHP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,200 r.p.m.</td>
<td>2.1</td>
<td>0.49</td>
<td>34.6</td>
</tr>
</tbody>
</table>

4. DRAWBAR TESTS

(1) The following Tables C, D, and E, show the drawbar performance of the tractor, on the bitumen test track, wearing rear tyres 13 x 28, carrying maximum weight (1,740 lb. front, 4,920 lb. rear; total 6,660 lb.), working in the gears named in the tables. Height of drawbar 15 inches.

Drawbar tests, using standard weight of tractor (4,500 lb.), were carried out, but are not reported here.

Table C.—Maximum Power Rated (2nd)

<table>
<thead>
<tr>
<th>Gear</th>
<th>D.B.H.P.</th>
<th>Pull lb.</th>
<th>Speed m.p.h.</th>
<th>Wheel Slip %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,450</td>
<td>1.7</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3,700</td>
<td>3.1</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2,800</td>
<td>4.2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1,800</td>
<td>6.3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1,500</td>
<td>8.0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Road speed not tested</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table D.—Pull at Maximum d.b.h.p.

<table>
<thead>
<tr>
<th>Gear</th>
<th>D.B.H.P.</th>
<th>Pull lb.</th>
<th>Speed m.p.h.</th>
<th>Wheel Slip %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 (i)</td>
<td>4,450</td>
<td>1.7</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>30 (j)</td>
<td>3,700</td>
<td>3.1</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>31½</td>
<td>2,800</td>
<td>4.2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>30½</td>
<td>1,800</td>
<td>6.3</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>31½</td>
<td>1,500</td>
<td>8.0</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Road speed not tested</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note.—Letters in brackets refer to explanatory footnotes.

(a) Corrected maximum h.p. is calculated by a suitable formula from observed maximum h.p. corrected to 60° F. and 29.92” (sea level) barometric pressure. No correction is applied to diesel engines because there is no suitable formula; the values shown above are therefore the observed maximum powers.

(b) Engine are not expected to run indefinitely at full or maximum power output. But they can be expected to run continuously for some hours at rated output, which is less than maximum, defined as follows:

(b1) Rated b.h.p. is defined as 85 per cent. of corrected maximum b.h.p.;
(b2) Rated d.b.h.p. is defined as 75 per cent. of corrected maximum d.b.h.p.

(c) Corrected maximum h.p. Is calculated by a suitable formula from observed maximum h.p. corrected to 60° F. and 29.92” (sea level) barometric pressure. No correction is applied to diesel engines because there is no suitable formula; the values shown above are therefore the observed maximum powers.

(d) This is the “specific fuel consumption,” the weight of fuel consumed per unit of energy developed by the engine; the unit of energy here is the hp.-hour, similar to the electrical “unit,” the kilowatt-hour. When this figure is least the engine is giving its best economy or efficiency. It is easy to change from column (e) to column (d) in Table B. e.g. as follows:

2.1 gals./hr. while developing 34.6 h.p. means 2.1 + 34.6 gals./b.h.p./hr. = 0.061 gals./b.h.p./hr.

0.061 gals./b.h.p./hr. x 8.17 lb./gallon for this fuel = 0.49 lb./b.h.p./hr., as shown in column (d).

(e) Line 37, Table B, represents the average performance one might expect from the engine while driving a variety of belt loads, from light to heavy. In terms of average fuel consumption, it means about 1½ gallons an hour.

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revolution counts divided by the former count gives the slip as a ratio, which can be written as a percentage (quoted in these tables to the nearest whole number).

These are not the maximum pulls available in the gears (i.e., not the maximum sustained pulls), but the pulls at maximum d.b. power, i.e., at full-throttle at rated engine speed.

<table>
<thead>
<tr>
<th>Pull lb</th>
<th>Speed m.p.h.</th>
<th>DBHP</th>
<th>Percentage of Maximum d.b.h.p.</th>
<th>Slip %</th>
<th>Fuel Gall./hr.</th>
<th>Fuel lb./d.b.h.p. hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,650</td>
<td>3.47</td>
<td>15</td>
<td>49</td>
<td>4</td>
<td>1.3</td>
<td>0.67</td>
</tr>
<tr>
<td>2,150</td>
<td>3.36</td>
<td>19</td>
<td>62</td>
<td>5</td>
<td>1.5</td>
<td>0.62</td>
</tr>
<tr>
<td>2,650†</td>
<td>3.32</td>
<td>23†</td>
<td>75†</td>
<td>6</td>
<td>1.7</td>
<td>0.60</td>
</tr>
<tr>
<td>3,500</td>
<td>3.17</td>
<td>30</td>
<td>95</td>
<td>9</td>
<td>2.1</td>
<td>0.57</td>
</tr>
</tbody>
</table>

† Rated drawbar load.

Table E.—Fuel Consumption, Various Loads, Rated (3rd) Gear

(2) Interpretation of Drawbar Tests.

(i) Drawbar tests are carried out on a hard prepared surface. Most field conditions present higher resistance to the tractor's motion, so that, in the field, the maximum drawbar pulls available in any gear will usually be less than those shown in the tables.

(ii) Wheel slip may also be greater in the field; to that extent tractor speeds in miles per hour in the field will be less than those shown in the tables.

(iii) Because of (i) and (ii) above, the drawbar horsepowers available in any gear in the field will usually be less than those shown in the tables.

5. OTHER OBSERVATIONS

(1) Duration of Test.—80 hours, including running-in.

(2) Repairs and Adjustments.—(1) High idle speed had to be raised from recommended 2,330 r.p.m. to 2,390 r.p.m. to obtain maximum power at rated speed.

(ii) Belt pulley/p.t.o. unit twice replaced because of overheating of the ratio selector fork.

(iii) Injector in No. 2 cylinder dismantled, cleaned, and reset twice during tests.

(3) Engine—

Fuel settings—one, fuel pump sealed.

Heat controls—radiator with adjustable blind, thermostat.

(4) Tractor Weights (lb.).

<table>
<thead>
<tr>
<th>Weight condition</th>
<th>Front</th>
<th>Rear</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard, unballasted (Pressed disc rear wheels)</td>
<td>1,460</td>
<td>3,040</td>
<td>4,500</td>
</tr>
<tr>
<td>Maximum weight, heaviest recommended (Special cast centre rear wheels)</td>
<td>1,740</td>
<td>4,920</td>
<td>6,660</td>
</tr>
</tbody>
</table>

Includes—

Water ballast (lb./wheel) | 50 | 160 | 210

Solid ballast (lb./wheel) | 90 | 300 | 390

(3) Engine—

Fuel settings—one, fuel pump sealed.

Heat controls—radiator with adjustable blind, thermostat.

Radiator water used—half-gallon.


Weight to engine, 16.5 lb.;

Weight from engine after tests, 13.9 lb.

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(8) Driver’s Accommodation.—Access to seat, from either side forward of rear wheels. Foot-room and support, flat foot plates, adequate. Comfort, metal plough type seat on rubber spring, adjustable fore and aft. Accessibility to controls, clutch and brake pedals 22” apart, pedals approximately 14” below loaded seat. Some controls are crowded.

(9) Instruments.—All clearly visible markings adequate. Indications were consistent throughout tests.

(10) Inspection of Engine and Transmission after Test.—After testing, the tractor was partly dismantled and inspected and found to be in a satisfactory condition, except that some signs of overheating were again noticed in the second replacement belt pulley/p.t.o. unit.

(11) Instruction Books.—Instructions for starting, running, and maintenance were satisfactory, and well illustrated.

G. H. VASEY, Officer in Charge Tractor Testing.
W. F. Ballie, Tractor Testing Officer.

6. BRIEF SPECIFICATIONS
David Brown 900 D. (Based on Information Supplied by Manufacturers)

(1) Engine—No. AD4/30H 2411.
4-stroke; 4 cylinders, vertical; crankshaft along tractor; direct injection diesel.
Bore, 3¾”; stroke, 4”; compression ratio, 15.9 : 1.
Rated speeds: Belt and drawbar work, 2,200 r.p.m.
Fuel type: Distillate.
Fuel system: C.A.V. rotary distributor pump, 4 hole spray type injectors. Two replaceable element filters in series. Tank capacity, 10 gallons.
Air Cleaner: Oil bath.
Governor: Mechanical, centrifugal incorporated in fuel pump.
Electrical system: 12-volt battery and generator.
Starting: Electric, cold start.
Cooling: Water (at atmospheric pressure) fan, pump, and thermostat, radiator blind adjustable from drivers seat.
Lubrication: Oil pump and by-pass filter.

(2) Chassis—
4-wheel; pneumatic tyres.
Wheel base 72”.
Track widths: Front 52” x 4” steps to 76”; rear 52” x 4” steps to 76”.
Tyre sizes: Front: 6.00 x 16; rear 13 x 28.
Steering: Single worm drive.
Weight: Maximum, 6,660 lb.
(See “Other Observations,” section 5).

(3) Belt Pulley—
Rear right side, clockwise rotation.
Diameter 8⅛”; face width 5⅜”.
2 speeds (at rated engine speed), high, 2,070 r.p.m.; low, 1,375 r.p.m.
Belt speed (at rated engine speed), low 3,200 ft./min. in accordance with overseas standards (namely, 3,100 ± 100 f.p.m.).

(4) Power-Take-Off—
Centre rear; clockwise; guarded.
2 speeds: high, 1,050 r.p.m.; low, 660 r.p.m.; not in accordance with overseas’ standards (namely, 536 ± 10 r.p.m.).
At engine speed of 1,800 r.p.m. p.t.o. would be 540 r.p.m. in low ratio.
Dimensions: 6 spline, 1⅛” diameter.
Note: Belt pulley and p.t.o. comprise a single unit.
(5) Drawbar Swinging—
Seven positions across. Height as tested, 15" (adjustable 13", 15", 18").
Removal of swinging drawbar leaves fixed drawbar with 10 holes across.
Linkage mounted drawbar also available.

(6) Transmission—
Conventional gears.
Clutch: Single dry plate; 10" diameter; pedal control and independent hand lever at left rear.
Gear ratios and road speeds (assuming no wheel slip) on 11.25 x 28 tyres, at rated engine speed, as advertised. (Tests were done on 13" tyres. Speeds would be approximately 7 per cent. higher on this account).

<table>
<thead>
<tr>
<th>Gear</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>H</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td>182.0</td>
<td>98.1</td>
<td>73.9</td>
<td>49.5</td>
<td>39.8</td>
<td>20.1</td>
<td>45.9</td>
<td>113.0</td>
</tr>
<tr>
<td>Speed, m.p.h.</td>
<td>1.7</td>
<td>3.1</td>
<td>4.2</td>
<td>6.2</td>
<td>7.7</td>
<td>15.2</td>
<td>6.7</td>
<td>2.7</td>
</tr>
</tbody>
</table>

(7) Hydraulics—
Built in, gear pump in transmission housing incorporates David Brown "traction control unit."

(8) Three-Point Leakage—
Generally conforms to BS1841-1951, Category 1.

Farm Tracks can be Dangerous

This type of damage occurs every year in the wheatbelt. Formed roads can be constructed by contract grader at less than £30 per mile. Where several farmers in a district need this type of work, they can bring a contractor into the district and guarantee an average two or three miles of road making per farm. You belong to a group, so why not try it!
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