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Australian tractor tests: Zetor 50 super: report on test no.35

G H. Vasey

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This Report is taken from the full Technical Report No. 35; 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 show in the Technical Report. Some values are taken from graphs shown in the Technical Report, which 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

Note: The tests are now carried out under a procedure in which the main tests of engine performance are done directly on the engine itself (removed from the tractor for the purpose), and not through the belt pulley.

The belt outlet has been abandoned as the main test at several overseas testing stations in favour of tests on the engine itself (Germany) or on the pto (Nebraska British Standard tests).

After running-in, three types of tests were carried out, in order to measure the performance of the engine, as directly measured by the power in the engine crankshaft (horse-power, shp), the performance of the power outlets, measured on the pto and belt pulley at their proper speeds, and the performance of the tractor as a whole, as measured by drawbar pull, tractor speed, wheel slip, and drawbar horse-power (dbhp), with the tractor running on a bitumen test track.

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

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. (See note (a) below)

<table>
<thead>
<tr>
<th>Gear</th>
<th>DBHP (d)</th>
<th>Pull lb.</th>
<th>Speed m.p.h.</th>
<th>Wheel Slip % (e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(g) 11</td>
<td>6,360</td>
<td>0·64</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>(g) 21</td>
<td>6,360</td>
<td>1·23</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>(g) 36</td>
<td>6,360</td>
<td>2·12</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>6,200</td>
<td>2·58</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>4,500</td>
<td>3·75</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>46</td>
<td>3,200</td>
<td>5·39</td>
<td>3·5</td>
</tr>
<tr>
<td>7</td>
<td>45</td>
<td>1,750</td>
<td>9·56</td>
<td>2·3</td>
</tr>
</tbody>
</table>

Table B.—Maximum Power, Rated (5th) Gear

<table>
<thead>
<tr>
<th>Gear</th>
<th>DBHP</th>
<th>Pull lb.</th>
<th>Speed m.p.h.</th>
<th>Wheel Slip %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>45</td>
<td>4,500</td>
<td>3·75</td>
<td>8</td>
</tr>
</tbody>
</table>

3.—DRAWBAR TESTS

(1) The following Tables B, C, and D, show the drawbar performance of the tractor on the bitumen test track, on rear tyres 14 x 28, carrying maximum weight (2,300 lb. front, 7,080 lb. rear; total 9,380 lb.), working in the gears named in the tables. Height of drawbar 16½ inches.

Drawbar tests, using unballasted weight of tractor (6,330 lb.), were carried out, but are not reported here.

Table C.—Pull at Maximum d.b.h.p.

<table>
<thead>
<tr>
<th>Gear</th>
<th>DBHP</th>
<th>Pull lb.</th>
<th>Speed m.p.h.</th>
<th>Wheel Slip</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(g) 11</td>
<td>6,360</td>
<td>0·64</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>(g) 21</td>
<td>6,360</td>
<td>1·23</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>(g) 36</td>
<td>6,360</td>
<td>2·12</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>43</td>
<td>6,200</td>
<td>2·58</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>4,500</td>
<td>3·75</td>
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</tr>
<tr>
<td>6</td>
<td>46</td>
<td>3,200</td>
<td>5·39</td>
<td>3·5</td>
</tr>
<tr>
<td>7</td>
<td>45</td>
<td>1,750</td>
<td>9·56</td>
<td>2·3</td>
</tr>
</tbody>
</table>

Table D.—Fuel Consumption, Various Loads, Rated (5th) Gear

<table>
<thead>
<tr>
<th>Pull lb.</th>
<th>Percent. of full load</th>
<th>Speed m.p.h.</th>
<th>DBHP</th>
<th>Slip %</th>
<th>Gal./ hr.</th>
<th>lb./ dbhp hr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
<td>44</td>
<td>4·30</td>
<td>23</td>
<td>1</td>
<td>1·6</td>
<td>0·55</td>
</tr>
<tr>
<td>2,500</td>
<td>56</td>
<td>4·22</td>
<td>28</td>
<td>2</td>
<td>1·8</td>
<td>0·52</td>
</tr>
<tr>
<td>3,200</td>
<td>71</td>
<td>4·13</td>
<td>35</td>
<td>3</td>
<td>2·1</td>
<td>0·49</td>
</tr>
<tr>
<td>4,200</td>
<td>93</td>
<td>3·91</td>
<td>44</td>
<td>5</td>
<td>2·6</td>
<td>0·48</td>
</tr>
</tbody>
</table>

(d) DBHP is the product of pull (lb.) and speed (m.p.h.) divided by 375.

(e) Wheel slip can be measured by noting that, in travelling a given distance, the back wheels make more turns when working under load than when running with no load on the drawbar. The differences in these 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).

(f) These are not the maximum pulls available in the gears (i.e., not the maximum sustained pulls), but the pulls at maximum dbh power, i.e., at full engine power at rated engine speed.

(g) Not full engine power, dbhp limited by wheel slip.

(2) 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 (h)</td>
<td>2,300</td>
<td>4,030</td>
<td>6,330</td>
</tr>
<tr>
<td>Full weight, heaviest recommended (i)</td>
<td>2,300</td>
<td>7,080</td>
<td>9,380</td>
</tr>
</tbody>
</table>

Includes—

- Water ballast (lb./wheel) | 405 | 405 |
- Solid ballast (lb./wheel) | 1,120 | 1,120 |

(h) This weight, including driver and fuel, was used in finding centre of gravity.

(i) Weight of tractor in drawbar tests quoted in this report.

(3) Wheels and Tyres.

<table>
<thead>
<tr>
<th>Tyres</th>
<th>Front</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Rib</td>
<td>Open centre bar tred</td>
</tr>
<tr>
<td>Size</td>
<td>6·50 x 20, 6-ply</td>
<td>14 x 28, 8-ply</td>
</tr>
<tr>
<td>Pressure</td>
<td>38 p.s.i.</td>
<td>14 p.s.i.</td>
</tr>
</tbody>
</table>
4.—THE TEST TRACTOR

(1) The test tractor was declared to have been chosen at random from the current run of production. It received no special attention during assembly; the standard pre-delivery checks usually carried out by the dealer were in this instance done by the Company's representatives at the Testing Station. The tractor was run-in for 12 hours at the testing station.

(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 Section 2 above, fast idling speed.)

(4) Gravity.—Distillate, Diesel Index 66, Specific Gravity 0.82; weight per Imperial gallon 8.15 lb.

(5) Specification.—Engine No. 0/105/01919. See also Section 7.

5.—OTHER OBSERVATIONS

(1) Duration of Test.—65 hours, including running-in.

(2) Repairs and Adjustments.—Injector nozzles were checked and adjusted during run-in.

(3) Engine.—Fuel pump setting checked within specified limits.

Radiator water used—none.

Lubricating oil—S.A.E., 30.

Weight to engine, 24.7 lb.

Weight from engine after tests, 22.8 lb.

(4) Steering.—With track widths, front 47\(\frac{3}{4}\) in., rear 58\(\frac{3}{4}\) in., wheel base 86\(\frac{3}{4}\) in.:

Turning circles: Without brakes 27 ft. 10 in. L.H., 27 ft. 0 in. R.H.; with brakes, 23 ft. 8 in. L.H. and R.H.

Comment: Easy to steer under load, sensitive to steering wheel; no power assistance.

(5) Centre of Gravity, with tractor un-ballasted 4\(\frac{1}{2}\) in. above and 31\(\frac{1}{2}\) in. forward of rear axle.

(6) Driver's Accommodation.—Access to seat, from either side forward of rear wheels, step on either mudguard. Footroom and support, adequate, driver's area fully floored.

Comfort: plough-type seat suspended on parallel linkage, coil springs and dampers, backrest, removable upholstery. Accessibility to controls, all controls conveniently placed and easily operated.

Noise: sound pressure level measured 3 ft. above loaded seat, in open field—
at full power, rated speed—107 units;
at fast idling speed—104 units.

The special unit is the decibel (db) of pressure compared with a base level of virtual silence. The levels quoted above are typical of tractors, which generally are noisy by accepted industrial standards.

(7) Instruments.—All clearly visible, metric units. Indications were consistent throughout tests. Engine tachometer also shows pto speed and road speeds in the gears.

(8) Inspection of Engine and Transmission after Test.—After testing, the tractor was partly dismantled and inspected and found to be in a satisfactory condition.

(9) Instruction Books.—English language instruction book not available at time of test.

6.—INTERPRETATION OF TESTS

(1) Power at Outlets (pto and Belt).

Pto and belt outlets should run at their recommended speeds, which in this instance conform to international standards. The figures shown in Table A represent the powers available at those speeds.

(2) Fuel Consumption.

Fuel consumption in galls./hour, though a simple unit often quoted, has little meaning unless the corresponding power output is also quoted. Specific fuel consumption (lb./hp-hr), the weight of fuel consumed per unit of energy developed, is a better guide. The unit of energy here is the hp-hr (similar to the electrical unit, the kilowatt-hr). When specific fuel consumption is least, the engine is giving its best economy or efficiency.

Gallons per/hr may be changed to lb./hp-hr as follows (referring to table A above):

\[
2.8 \text{ gallons/hr while developing 54.9 hp means}
\]

\[
2.8 \times 54.9 \text{ gals/shp/hr—} 0.051 \text{ gal./shp/hr.}
\]

\[
0.051 \text{ gal./shp/hr} \times 8.15 \text{ lb./gallon for this fuel—}
\]

\[
0.42 \text{ lb/shp-hr, as shown.}
\]

(3) Drawbar Tests.

(i) Drawbar tests are carried out on a hard prepared surface. Most field condi-
tions 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.

7.—BRIEF SPECIFICATIONS
Zetor 50 Super
(Based on Information Supplied by Manufacturers)

(1) Engine—No. 0/105/01919.
4-stroke; 4 cylinders, vertical; crankshaft along tractor; direct injection diesel.
Rated speed: 1,650 rpm.
Other recommended speeds: for pto work, 1,550 rpm.
Fuel type: Distillate.
Fuel system: Motorpal 4-cyl. in-line pump, 6-hole spray type injectors. Two replaceable-element filters in series. Tank capacity, 15 gallons.
Air Cleaner: Oil bath, gauze and centrifugal pre-cleaner.
Governor: Mechanical, incorporated in fuel pump.
Electrical system: 12-volt battery and generator.
Starting: Electric, air heater for each cylinder in intake duct. Decompressor on inlet valves and excess fuel control on pump for extra cold starting.
Exhaust: Vertical ahead of operator.
Lubrication: Oil pump, sump gauze filter, external full flow gauze filter and replaceable element by-pass filter.

(2) Chassis—
4-wheel; pneumatic tyres. Wheelbase 86\(\frac{3}{4}\) in.
Track widths: Front 50\(\frac{1}{2}\) in. x 6\(\frac{1}{4}\) in. steps to 69\(\frac{1}{4}\) in.; rear 54\(\frac{1}{2}\) in. adjustable to 71\(\frac{3}{4}\) in.
Tyre sizes: Front 6.50 x 20; rear 14 x 28.
Steering: Nut and screw drive.
Weight: Maximum, 9,380 lb.
(See Section 3 (2) above).

(3) Belt Pulley—
Rear (mounted on pto), rearward working in either direction.
Diameter 9\(\frac{3}{4}\) in.; face width 6\(\frac{3}{4}\) in.
Speed (at 1,650 rpm engine speed), 1,210 rpm.
Belt speed (at 1,650 rpm engine speed), 3,110 ft./min. in accordance with overseas standards (namely, 3,100 ± 100 fpm).

(4) Power Take-Off—
Centre read; clockwise; guarded.
Speed: at 1,550 rpm engine speed, 538 rpm, in accordance with overseas standards (namely, 536 ± 10 rpm).
Dimensions: 6 spline, 1\(\frac{3}{4}\) in. diameter.

(5) Drawbar—Swinging—7 positions across.
Height, as tested 16\(\frac{1}{4}\) in. not adjustable. Removal of swinging drawbar leaves fixed drawbar. Trailer hitch with quick release pin (height adjustable 26 in.-30 in.) and front towing hook (max. rating 1,200 lb.) also provided.
Linkage mounted drawbar optional extra.

(6) Transmission—Conventional gears.
Clutch: Double dry plate; main 13\(\frac{3}{4}\) in. dia., live drive 11 in. dia.
Gear ratios and road speeds (assuming no wheel slip) on 14 x 28 tyres, at rated engine speed, as advertised (see table).

(7) Hydraulics—Built in, 4-cyl. pump in final drive housing.

(8) Three-Point Linkage—Generally conforms to BS1841-1951, Category 2.