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Test 834: Minneapolis-Moline G706 (LPG)

Nebraska Tractor Test Lab

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NEBRASKA TRACTOR TEST 834 - MINNEAPOLIS-MOLINE G706 LPG

(ALSO MASSEY-FERGUSON MF97 FOUR-WHEEL DRIVE LPG)

The University of Nebraska Agricultural Experiment Station

E. F. Frolik, Dean; H. H. Kramer, Director, Lincoln, Nebraska

POWER TAKE-OFF PERFORMANCE

| Hp | Crank- shaft speed rpm | Fuel Consumption | | Hp-hr per gal | Temperature Degrees F | | | Barometer inches of Mercury |
|--|---------------------------------|------------------|--------------------|---------------------|-----------------------|--------------------|--------------------|-----------------------------------|
| | | Gal per hr | Lb per hp-hr | | Cooling medium | Air wet bulb | Air dry bulb | |
| MAXIMUM POWER AND FUEL CONSUMPTION | | | | | | | | |
| Rated Engine Speed—Two Hours | | | | | | | | |
| 101.44 | 1600 | 11.372 | 0.476 | 8.92 | 178 | 55 | 75 | 28.568 |
| Standard Power Take-off Speed (540 rpm)—One Hour | | | | | | | | |
| 82.29 | 1200 | 8.906 | 0.460 | 9.24 | 179 | 56 | 75 | 28.588 |
| VARYING POWER AND FUEL CONSUMPTION—TWO HOURS | | | | | | | | |
| 91.12 | 1691 | 9.953 | 0.464 | 9.16 | 176 | 57 | 78 | ..... |
| 0.00 | 1837 | 3.330 | | | 157 | 55 | 74 | ..... |
| 47.32 | 1757 | 6.699 | 0.602 | 7.06 | 173 | 56 | 75 | ..... |
| 102.01 | 1600 | 11.407 | 0.475 | 8.94 | 178 | 56 | 75 | ..... |
| 24.31 | 1803 | 5.012 | 0.876 | 4.85 | 167 | 55 | 74 | ..... |
| 69.68 | 1724 | 8.216 | 0.501 | 8.48 | 176 | 57 | 76 | ..... |
| Av 55.74 | 1735 | 7.436 | 0.567 | 7.50 | 171 | 56 | 75 | 28.618 |

DRAWBAR PERFORMANCE

| Hp | Drawbar pull lbs | Speed miles per hr | Crank- shaft speed rpm | Slip of drivers % | Fuel Consumption | | | Temp Degrees F | | | Barometer inches of Mercury |
|---|------------------------|-----------------------------|---------------------------------|----------------------------|------------------|--------------------|---------------------|---------------------|--------------------|--------------------|-----------------------------------|
| | | | | | Gal per hr | Lb per hp-hr | Hp-hr per gal | Cool- ing med | Air wet bulb | Air dry bulb | |
| VARYING DRAWBAR POWER AND FUEL CONSUMPTION WITH BALLAST | | | | | | | | | | | |
| Maximum Available Power—Two Hours—3rd Gear | | | | | | | | | | | |
| 86.24 | 6452 | 5.01 | 1596 | 4.88 | 11.029 | 0.544 | 7.82 | 181 | 54 | 73 | 28.665 |
| 75% of Pull at Maximum Power—Ten Hours—3rd Gear | | | | | | | | | | | |
| 72.06 | 5063 | 5.34 | 1678 | 3.65 | 9.212 | 0.543 | 7.82 | 172 | 42 | 47 | 28.715 |
| 50% of Pull at Maximum Power—Two Hours—3rd Gear | | | | | | | | | | | |
| 50.09 | 3407 | 5.51 | 1709 | 2.20 | 7.265 | 0.616 | 6.89 | 179 | 55 | 75 | 28.640 |
| MAXIMUM POWER WITH BALLAST | | | | | | | | | | | |
| 86.13 | 11293 | 2.86 | 1602 | 10.54 | 1st Gear | ..... | 178 | 55 | 75 | 28.635 | |
| 90.09 | 7928 | 4.26 | 1607 | 6.16 | 2nd Gear | ..... | 182 | 53 | 69 | 28.685 | |
| 90.26 | 6731 | 5.03 | 1604 | 5.08 | 3rd Gear | ..... | 178 | 49 | 60 | 28.695 | |
| 88.40 | 4504 | 7.36 | 1602 | 3.35 | 4th Gear | ..... | 178 | 53 | 69 | 28.685 | |
| MAXIMUM POWER WITHOUT BALLAST | | | | | | | | | | | |
| 88.74 | 6920 | 4.81 | 1600 | 10.98 | 3rd Gear | ..... | 180 | 44 | 55 | 29.095 | |

VARYING DRAWBAR PULL AND TRAVEL SPEED WITH BALLAST—3rd Gear

| | | | | | | | |
|----------------------|-------|-------|-------|-------|-------|-------|-------|
| Pounds pull | 6731 | 7050 | 7277 | 7332 | 7377 | 7507 | 7369 |
| Horsepower | 90.26 | 84.84 | 77.75 | 68.70 | 58.77 | 49.82 | 39.84 |
| Crankshaft speed rpm | 1604 | 1443 | 1283 | 1127 | 959 | 799 | 652 |
| Miles per hour | 5.03 | 4.51 | 4.01 | 3.51 | 2.99 | 2.49 | 2.03 |
| Slip of drivers % | 5.08 | 5.42 | 5.42 | 5.56 | 5.82 | 5.69 | 5.56 |

TIRES, BALLAST and WEIGHT

| | | With Ballast | Without Ballast |
|----------------------------|----------------------|--------------------|--------------------|
| Rear tires | —No, size, ply & psi | Two 23.1-26; 8; 16 | Two 23.1-26; 8; 16 |
| Ballast | —Liquid | 1555 lb each | None |
| | Cast iron | 2000 lb each | None |
| Front tires | —No, size, ply & psi | Two 9.5-24; 6; 25 | Two 9.5-24; 6; 28 |
| Ballast | —Liquid | None | None |
| | Cast iron | None | None |
| Height of drawbar | | 11½ inches | 14½ inches |
| Static weight | —Rear | 12090 lb | 4980 lb |
| | Front | 3770 lb | 3860 lb |
| Total weight with operator | | 16035 lb | 9015 lb |

Department of Agricultural Engineering
 Dates of Test: April 8 to April 23, 1963
 Manufacturer: MINNEAPOLIS-MOLINE, INC.,
 HOPKINS, MINNESOTA
 Manufacturer's Power Rating: Not rated

FUEL, OIL and TIME Fuel commercial propane Specific gravity converted to 60°/60° 0.5103 Weight per gallon 4.25 lb Oil SAE 20-20W API service classification MM To motor 3.192 gal Drained from motor 2.615 gal Transmission and final-drive lubricant SAE 90 Type EP Total time engine was operated 49½ hours.

ENGINE Make Minneapolis-Moline LPG Type 6 cylinder vertical Serial No 23600211 Crankshaft mounted lengthwise Rated rpm 1600 Bore and stroke 4⅝" x 5" Compression ratio 8.0 to 1 Displacement 504 cu in Carburetor size 1½" Ignition system battery Cranking system 12 volt electric (two 12-volt batteries) Lubrication pressure Air cleaner oil washed wire screen Oil filter cotton element Muffler was used Cooling medium temperature control two thermostats.

CHASSIS Type 4-wheel drive Serial No 23800117 Tread width rear 72¼" front 68¼" Wheel base 84½" Center of gravity (without operator or ballast, with minimum tread, with fuel tank filled and tractor serviced for operation) Horizontal distance forward from centerline of rear wheels 32.8" Vertical distance above roadway 35" Horizontal distance from center of rear wheel tread 0" to the right/left Hydraulic control system direct engine drive Transmission selective gear fixed ratio Advertised speeds mph first 3.3 second 4.7 third 5.5 fourth 7.9 fifth 18.3 reverse 2.56 Clutch double disc over center operated by hand lever Brakes double disc operated by two foot pedals Steering mechanical with power assist Turning radius (on concrete surface with brake applied) right 171" left 169" (on concrete surface without brake) right 251" left 252" Turning space diameter (on concrete surface with brake applied) right 338" left 342" (on concrete surface without brake) right 512" left 513" Belt pulley 741 rpm at 1300 engine rpm diam 16" face 7" Power take-off 540 rpm at 1200 engine rpm Belt speed 3110 fpm.

REPAIRS and ADJUSTMENTS

The rain cap on the exhaust pipe was re-welded before starting the PTO runs.

The PTO shaft, PTO dog clutch, transmission-PTO connecting shaft, transmission lower counter shaft, and transmission lower countershaft bearings were replaced due to failure of the transmission lower countershaft during the preliminary PTO runs.

During preliminary PTO runs it was necessary to install a dampening device to control governor hunting.

REMARKS All test results were determined from observed data obtained in accordance with the SAE and ASAE test code.

Fifth gear was not run as it exceeded 15 mph.

We, the undersigned, certify that this is a true and correct report of official Tractor Test 834.

L. F. LARSEN

Engineer-in-Charge

L. W. HURLBUT, Chairman
 G. W. STEINBRUEGGE
 J. J. SULEK
 Board of Tractor Test
 Engineers

EXPLANATION OF TEST REPORT

GENERAL CONDITIONS

Each tractor is a production model equipped for common usage. Power consuming accessories can be disconnected only when it is convenient for the operator to do so in practice. Additional weight can be added as ballast if the manufacturer regularly supplies it for sale. The static tire loads and the inflation pressures must conform to recommendations in the Tire Standards published by the Society of Automotive Engineers.

PREPARATION FOR PERFORMANCE RUNS

The engine crankcase is drained and refilled with a measured amount of new oil conforming to specifications in the operators manual. The fuel used and the maintenance operations must also conform to the published information delivered with the tractor. The tractor is then limbered-up for 12 hours on drawbar work in accordance with the manufacturer's published recommendations. The manufacturer's representative is present to make appropriate decisions regarding mechanical adjustments.

The tractor is equipped with approximately the amount of added ballast that is used during maximum drawbar tests. The tire tread-bar height must be at least 65% of new tread height prior to the maximum power run.

BELT OR POWER TAKE-OFF PERFORMANCE

Maximum Power and Fuel Consumption. The manufacturer's representative makes carburetor, fuel pump, ignition and governor control settings which remain unchanged throughout all subsequent runs. The governor and the manually operated governor control lever is set to provide the high-idle speed specified by the manufacturer for maximum power. Maximum power is measured by connecting the belt pulley or the power take-off to a dynamometer. The dynamometer load is then gradually increased until the engine is operating at the rated speed specified by the manufacturer for maximum power. The corresponding fuel consumption is measured.

Varying Power and Fuel Consumption. Six different horsepower levels are used to show corresponding fuel consumption rates and how the governor causes the engine to react to the following changes in dynamometer load: 85% of the dynamometer torque at maximum power; minimum dynamometer torque, $\frac{1}{2}$ the 85% torque; maximum power, $\frac{1}{4}$ and $\frac{3}{4}$ of the 85% torque. Since a tractor is generally subjected to varying loads the average of the results in this test serve well for predicting the fuel consumption of a tractor in general usage.

DRAWBAR PERFORMANCE

All engine adjustments are the same as those used in the belt or power take-off tests. If the manufacturer specifies a different rated crankshaft speed for drawbar operations, then the position of the manually operated governor control is changed to provide the high-idle speed specified by the manufacturer in the operating instructions.

Varying Power and Fuel Consumption With Ballast. The varying power runs are made to show the effect of speed-control devices (engine governor, automatic trans-

mission, etc.) on horsepower, speed and fuel consumption. These runs are made around the entire test course which has two 180 degree turns with a minimum radius of 50 feet. The drawbar pull is set at 3 different levels as follows: (1) as near to the pull at maximum power as possible and still have the tractor maintain the travel speed at maximum horsepower on the straight sections of the test course; (2) 75% of the pull at maximum power; and (3) 50% of the pull at maximum power. Prior to 1958, fuel consumption data (10 hour test) were shown only for the pull obtained at maximum power for tractors having torque converters and at 75% of the pull obtained at maximum power for gear-type tractors.

Maximum Power with Ballast. Maximum power is measured on straight level sections of the test course. Data are shown for not more than 12 different gears or travel speeds. Some gears or travel speeds may be omitted because of high slippage of the traction members or because the travel speed may exceed the safe-limit for the test course. The maximum safe speed for the Nebraska Test Course has been set at 15 miles per hour. The slippage limits have been set at 15% and 7% for pneumatic tires and steel tracks or lugs, respectively. Higher slippage gives widely varying results.

Maximum Power Without Ballast. All added ballast is removed from the tractor. The maximum drawbar power of the tractor is determined by the same procedure used for getting maximum power with ballast. The gear (or travel speed) is the same as that used in the 10-hour test.

Varying Power and Travel Speed with Ballast. Travel speeds corresponding to drawbar pulls beyond the maximum power range are obtained to show the "lugging ability" of the tractor. The run starts with the pull at maximum power; then additional drawbar pull is applied to cause decreasing speeds. The run is ended by one of three conditions: (1) maximum pull is obtained, (2) the maximum slippage limit is reached, or (3) some other operating limit is reached.

For additional information about the Nebraska Tractor Tests write to the Department of Agricultural Engineering, University of Nebraska, Lincoln, Nebraska.



Minneapolis-Moline G706 LPG