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January 1996

## Test 1648/1: Buhler Versatile 2160 Diesel

Nebraska Tractor Test Lab

University of Nebraska-Lincoln, [tractortestlab@unl.edu](mailto:tractortestlab@unl.edu)

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# SUMMARY OF OECD TEST 1648/1-NEBRASKA SUMMARY 219A

## BUHLER VERSATILE 2160 DIESEL

### 16 SPEED

#### POWER TAKE-OFF PERFORMANCE

| Power<br>HP<br>(kW)                      | Crank<br>shaft<br>speed<br>rpm | Gal/hr<br>(l/h)  | lb/hp.hr<br>(kg/kW.h) | Hp.hr/gal<br>(kW.h/l) | Mean Atmospheric<br>Conditions |
|--|--------------------------------|------------------|-----------------------|-----------------------|--------------------------------|
| MAXIMUM POWER AND FUEL CONSUMPTION       |                                |                  |                       |                       |                                |
| Rated Engine Speed—(PTO speed—1103 rpm)  |                                |                  |                       |                       |                                |
| 164.8<br>(122.9)                         | 2100                           | 9.90<br>(37.47)  | 0.427<br>(0.260)      | 16.65<br>(3.28)       |                                |
| Standard Power Take-off Speed (1000 rpm) |                                |                  |                       |                       |                                |
| 179.4<br>(133.8)                         | 1903                           | 10.04<br>(38.01) | 0.398<br>(0.242)      | 17.87<br>(3.52)       |                                |
| Maximum Power (2 hours)                  |                                |                  |                       |                       |                                |
| 185.9<br>(138.7)                         | 1700                           | 9.96<br>(37.71)  | 0.381<br>(0.232)      | 18.65<br>(3.67)       |                                |

#### VARYING POWER AND FUEL CONSUMPTION

|                  |      |                 |                  |                 |                       |
|------------------|------|-----------------|------------------|-----------------|-----------------------|
| 164.8<br>(122.9) | 2100 | 9.90<br>(37.47) | 0.427<br>(0.260) | 16.65<br>(3.28) | Air temperature       |
| 145.6<br>(108.6) | 2184 | 9.14<br>(34.59) | 0.447<br>(0.272) | 15.94<br>(3.14) | 81°F (27°C)           |
| 110.8<br>(82.6)  | 2215 | 7.47<br>(28.27) | 0.480<br>(0.292) | 14.82<br>(2.92) | Relative humidity     |
| 75.1<br>(56.0)   | 2250 | 5.72<br>(21.66) | 0.542<br>(0.330) | 13.12<br>(2.58) | 73%                   |
| 38.0<br>(28.3)   | 2275 | 4.13<br>(15.62) | 0.773<br>(0.471) | 9.21<br>(1.82)  | Barometer             |
| 3.1<br>(2.3)     | 2294 | 2.59<br>(9.82)  | 5.951<br>(3.620) | 1.20<br>(0.24)  | 28.86" Hg (97.74 kPa) |

Maximum Torque - 632.2 lb.-ft. (857.2 Nm) at 1380 rpm

Maximum Torque Rise - 53.4%

Torque rise at 1700 engine rpm - 39%

#### DRAWBAR PERFORMANCE

(Unballasted - Front Drive Engaged)

#### FUEL CONSUMPTION CHARACTERISTICS

| Power<br>Hp<br>(kW)                           | Drawbar<br>pull<br>lbs<br>(kN) | Speed<br>mph<br>(km/h) | Crank-<br>shaft<br>speed<br>rpm | Slip<br>% | Fuel Consumption<br>lb/hp.hr<br>(kg/kW.h) | Hp.hr/gal<br>(kW.h/l) | Temp.°F (°C)<br>cool-<br>ing<br>med | Air<br>dry<br>bulb | Barom.<br>inch<br>Hg<br>(kPa) |
|---|--------------------------------|------------------------|---------------------------------|-----------|---|-----------------------|-------------------------------------|--------------------|-------------------------------|
| Maximum Power—9th Gear                        |                                |                        |                                 |           |   |                       |                                     |                    |                               |
| 142.3<br>(106.1)                              | 8440<br>(37.54)                | 6.32<br>(10.17)        | 2102                            | 2.3       | 0.487<br>(0.296)                          | 14.62<br>(2.88)       | 186<br>(86)                         | 70<br>(21)         | 29.32<br>(99.29)              |
| 75% of Pull at Maximum Power—9th Gear         |                                |                        |                                 |           |   |                       |                                     |                    |                               |
| 111.4<br>(83.1)                               | 6315<br>(28.09)                | 6.62<br>(10.65)        | 2187                            | 1.8       | 0.539<br>(0.328)                          | 13.20<br>(2.60)       | 185<br>(85)                         | 70<br>(21)         | 29.32<br>(99.29)              |
| 50% of Pull at Maximum Power—9th Gear         |                                |                        |                                 |           |   |                       |                                     |                    |                               |
| 76.2<br>(56.8)                                | 4225<br>(18.80)                | 6.76<br>(10.88)        | 2222                            | 1.2       | 0.613<br>(0.373)                          | 11.60<br>(2.29)       | 184<br>(84)                         | 70<br>(21)         | 29.32<br>(99.29)              |
| 75% of Pull at Reduced Engine Speed—10th Gear |                                |                        |                                 |           |   |                       |                                     |                    |                               |
| 111.6<br>(83.2)                               | 6330<br>(28.15)                | 6.61<br>(10.64)        | 1865                            | 1.6       | 0.467<br>(0.284)                          | 15.23<br>(3.00)       | 185<br>(85)                         | 75<br>(24)         | 29.31<br>(99.24)              |
| 50% of Pull at Reduced Engine Speed—10th Gear |                                |                        |                                 |           |   |                       |                                     |                    |                               |
| 75.9<br>(56.6)                                | 4225<br>(18.79)                | 6.74<br>(10.84)        | 1890                            | 1.1       | 0.523<br>(0.318)                          | 13.60<br>(2.68)       | 181<br>(83)                         | 75<br>(24)         | 29.31<br>(99.24)              |

**Location of Test:** Prairie Agricultural Machinery Institute (PAMI), Portage La Prairie, Manitoba, Canada

**Dates of Test:** July - August 1996.

**Manufacturer:** Buhler Versatile Inc., 1260 Clarence Ave., Winnipeg, Manitoba, Canada R3C 4E8

**FUEL and OIL:** Fuel No. 2 Diesel **Specific gravity converted to 60°/60°F (15°/15°C)** 0.8544 **Fuel weight** 7.114 lbs/gal (0.8526 kg/l) **Oil SAE** 15W40 **API service classification** CF-4 **Transmission and hydraulic lubricant** ESN-M2C134 fluid **Front axle lubricant** ESN-M2C134 fluid

**ENGINE:** Make New Holland Diesel **Type** six cylinder vertical with turbocharger and air to air intercooler **Serial No.** VH601084 **Crankshaft** lengthwise **Rated engine speed** 2100 **Bore and stroke** 4.40" x 5.00" (111.8 mm x 127.0 mm) **Compression ratio** 17.5 to 1 **Displacement** 456 cu in (7480 ml) **Starting system** 12 volt **Lubrication** pressure **Air cleaner** two paper elements and aspirator **Oil filter** one full flow cartridge **Oil cooler** engine coolant heat exchanger for crankcase oil, radiator for hydraulic and transmission oil **Fuel filter** one cartridge **Muffler** underhood **Exhaust** vertical **Cooling medium temperature control** thermostat and variable speed fan

**CHASSIS:** **Type** front wheel assist **Serial No.** D409192 **Tread width** rear 60.0" (1524 mm) to 124.0" (3150 mm) front 60.0" (1524 mm) to 88.0" (2235 mm) **Wheelbase** 122.6" (3115 mm) **Hydraulic control system** direct engine drive **Transmission** selective gear fixed ratio with full range operator controlled powershift **Nominal travel speeds mph (km/h)** first 1.77 (2.85) second 2.09 (3.37) third 2.45 (3.94) fourth 2.81 (4.52) fifth 3.32 (5.34) sixth 3.88 (6.24) seventh 4.57 (7.35) eighth 5.34 (8.59) ninth 6.31 (10.15) tenth 7.38 (11.88) eleventh 8.46 (13.61) twelfth 10.00 (16.09) thirteenth 11.69 (18.81) fourteenth 13.77 (22.16) fifteenth 16.27 (26.19) sixteenth 19.04 (30.64) reverse 2.39 (3.85), 2.83 (4.55), 3.31 (5.32), 3.79 (6.10), 4.47 (7.20), 5.24 (8.43), 6.16 (9.92), 7.29 (11.73), 8.53 (13.72) **Clutch** multiple wet disc electro-hydraulically operated by foot pedal **Brakes** multiple wet disc hydraulically actuated by two foot pedals that can be locked together **Steering** hydrostatic **Power take-off** 1000 rpm at 1903 engine rpm **Unladen tractor mass** 19285 lb (8748 kg)

**DRAWBAR PERFORMANCE**  
**(Unballasted - Front Drive Engaged)**  
**MAXIMUM POWER IN SELECTED GEARS**

| Power<br>Hp<br>(kW) | Drawbar<br>pull<br>lbs<br>(kN) | Speed<br>mph<br>(km/h) | Crank-<br>shaft<br>speed<br>rpm | Slip<br>% | Fuel<br>lb/hp.hr<br>(kg/kW.h) | Consumption<br>Hp.hr/gal<br>(kW.h/l) | Temp. °F(°C)<br>cool-<br>ing<br>med | Air<br>dry<br>bulb | Barom.<br>inch<br>Hg<br>(kPa) |
|---------------------|--------------------------------|------------------------|---------------------------------|-----------|-------------------------------|--------------------------------------|-------------------------------------|--------------------|-------------------------------|
| 140.8<br>(105.0)    | 18635<br>(82.89)               | 2.83<br>(4.56)         | 1764                            | 15.0      | 6th Gear<br>0.508<br>(0.309)  | 14.01<br>(2.76)                      | 185<br>(85)                         | 68<br>(20)         | 29.32<br>(99.29)              |
| 158.1<br>(117.9)    | 16625<br>(73.96)               | 3.57<br>(5.74)         | 1702                            | 5.9       | 7th Gear<br>0.446<br>(0.271)  | 15.99<br>(3.15)                      | 186<br>(86)                         | 68<br>(20)         | 29.32<br>(99.29)              |
| 160.4<br>(119.6)    | 14135<br>(62.87)               | 4.26<br>(6.85)         | 1702                            | 5.0       | 8th Gear<br>0.439<br>(0.267)  | 16.19<br>(3.19)                      | 186<br>(86)                         | 68<br>(20)         | 29.32<br>(99.29)              |
| 163.9<br>(122.2)    | 12085<br>(53.76)               | 5.09<br>(8.18)         | 1701                            | 3.1       | 9th Gear<br>0.432<br>(0.263)  | 16.45<br>(3.24)                      | 185<br>(85)                         | 68<br>(20)         | 29.32<br>(99.29)              |
| 162.5<br>(121.2)    | 10175<br>(45.26)               | 5.99<br>(9.64)         | 1702                            | 2.3       | 10th Gear<br>0.434<br>(0.264) | 16.40<br>(3.23)                      | 185<br>(85)                         | 68<br>(20)         | 29.32<br>(99.29)              |

**REPAIRS AND ADJUSTMENTS:** No repairs or adjustments

**NOTE:** The data on this summary was obtained from OECD report 1648/1 conducted on the New Holland 8770 Diesel.

**REMARKS:** All test results were determined from observed data obtained in accordance with official OECD test procedures. The optional hydraulic flow rate claim of 55.0 GPM (208 lpm) was not tested for verification. The performance figures on this summary were taken from a test conducted under the OECD Code II test procedure.

We, the undersigned, certify that this is a true summary of data from OECD Report No. **1648/1** Nebraska Summary 219A, September 1, 2004.

Leonard L. Bashford  
Director

M.F. Kocher  
V.I. Adamchuk  
W.P. Campbell  
Board of Tractor Test Engineers

| TRACTOR SOUND LEVEL WITH CAB | dB(A) |
|------------------------------|-------|
| At 75% load in 10th gear     | 75.0  |
| Bystander                    | --    |

**TIRES, BALLAST AND WEIGHT**

|  | With Ballast             | Without Ballast          |
|--|--------------------------|--------------------------|
| <b>Rear Tires</b> -No., size, ply & psi (kPa)  | Four 20.8R42;**, 8 (55)  | Two 20.8R42;**, 16 (110) |
| <b>Ballast</b> - Duals (total)                 | 1950 lb (884 kg)         | None                     |
| - Cast Iron (total)                            | 185 lb (84 kg)           | None                     |
| <b>Front Tires</b> -No., size, ply & psi (kPa) | Two 16.9R30;**, 16 (110) | Two 16.9R30;**, 12 (83)  |
| <b>Ballast</b> - Liquid (total)                | None                     | None                     |
| - Cast Iron (total)                            | 745 lb (337 kg)          | None                     |
| <b>Height of Drawbar</b>                       | 19.5 in (495 mm)         | 19.7 in (500 mm)         |
| <b>Static Weight with operator</b> - Rear      | 15015 lb (6810 kg)       | 13015 lb (5904 kg)       |
| - Front  | 7315 lb (3318 kg)        | 6435 lb (2919 kg)        |
| - Total  | 22330 lb (10128 kg)      | 19450 lb (8823 kg)       |

**DRAWBAR PERFORMANCE**  
**(Ballasted - Front Drive Engaged)**  
**FUEL CONSUMPTION CHARACTERISTICS**

| Power<br>Hp<br>(kW)                                 | Drawbar<br>pull<br>lbs<br>(kN) | Speed<br>mph<br>(km/h) | Crank-<br>shaft<br>speed<br>rpm | Slip<br>% | Fuel<br>lb/hp.hr<br>(kg/kW.h) | Consumption<br>Hp.hr/gal<br>(kW.h/l) | Temp.°F (°C)<br>cool-<br>ing<br>med | Air<br>dry<br>bulb | Barom.<br>inch<br>Hg<br>(kPa) |
|---|--------------------------------|------------------------|---------------------------------|-----------|-------------------------------|--------------------------------------|-------------------------------------|--------------------|-------------------------------|
| <b>Maximum Power—8th Gear</b>                       |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 141.6<br>(105.6)                                    | 9930<br>(44.17)                | 5.35<br>(8.61)         | 2100                            | 2.6       | 0.489<br>(0.298)              | 14.52<br>(2.86)                      | 187<br>(86)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>75% of Pull at Maximum Power—8th Gear</b>        |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 111.2<br>(82.9)                                     | 7445<br>(33.11)                | 5.60<br>(9.01)         | 2190                            | 2.1       | 0.542<br>(0.330)              | 13.12<br>(2.59)                      | 185<br>(85)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>50% of Pull at Maximum Power—8th Gear</b>        |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 75.7<br>(56.4)                                      | 4960<br>(22.06)                | 5.72<br>(9.21)         | 2226                            | 1.7       | 0.620<br>(0.377)              | 11.47<br>(2.26)                      | 185<br>(85)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>75% of Pull at Reduced Engine Speed—9th Gear</b> |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 110.6<br>(82.4)                                     | 7440<br>(33.09)                | 5.57<br>(8.97)         | 1846                            | 1.3       | 0.477<br>(0.290)              | 14.92<br>(2.94)                      | 187<br>(86)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>50% of Pull at Reduced Engine Speed—9th Gear</b> |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 75.6<br>(56.4)                                      | 4960<br>(22.07)                | 5.72<br>(9.20)         | 1884                            | 0.8       | 0.534<br>(0.325)              | 13.33<br>(2.63)                      | 183<br>(84)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>MAXIMUM POWER IN SELECTED GEARS</b>              |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| <b>4th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 134.2<br>(100.1)                                    | 22915<br>(101.92)              | 2.20<br>(3.53)         | 1900                            | 15.0      | 0.536<br>(0.326)              | 13.27<br>(2.61)                      | 187<br>(86)                         | 77<br>(25)         | 29.13<br>(98.65)              |
| <b>5th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 150.9<br>(112.5)                                    | 20980<br>(93.32)               | 2.70<br>(4.34)         | 1800                            | 6.6       | 0.469<br>(0.285)              | 15.18<br>(2.99)                      | 187<br>(87)                         | 77<br>(25)         | 29.13<br>(98.65)              |
| <b>6th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 156.0<br>(116.3)                                    | 19170<br>(85.28)               | 3.05<br>(4.91)         | 1698                            | 4.4       | 0.452<br>(0.275)              | 15.74<br>(3.10)                      | 185<br>(85)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>7th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 158.8<br>(118.4)                                    | 16345<br>(72.70)               | 3.64<br>(5.86)         | 1698                            | 3.1       | 0.447<br>(0.272)              | 15.89<br>(3.13)                      | 187<br>(86)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>8th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 160.1<br>(119.4)                                    | 13930<br>(61.96)               | 4.31<br>(6.94)         | 1700                            | 2.9       | 0.444<br>(0.270)              | 16.04<br>(3.16)                      | 187<br>(86)                         | 77<br>(25)         | 29.11<br>(98.59)              |
| <b>9th Gear</b>                                     |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 158.6<br>(118.3)                                    | 11660<br>(51.86)               | 5.10<br>(8.21)         | 1703                            | 2.0       | 0.444<br>(0.270)              | 16.01<br>(3.15)                      | 187<br>(86)                         | 79<br>(26)         | 29.13<br>(98.64)              |
| <b>10th Gear</b>                                    |                                |                        |                                 |           |                               |                                      |                                     |                    |                               |
| 157.2<br>(117.2)                                    | 9840<br>(43.76)                | 5.99<br>(9.64)         | 1701                            | 1.5       | 0.446<br>(0.271)              | 15.99<br>(3.15)                      | 187<br>(86)                         | 79<br>(26)         | 29.13<br>(98.64)              |

## THREE POINT HITCH PERFORMANCE (OECD Static Test)

CATEGORY: II

Quick Attach: None

Maximum Force Exerted

Through Whole Range: 12140 lbs (54.0 kN) (4" lift cylinders)

i) Opening pressure of relief valve: NA

Sustained pressure of the open relief valve: 2785 psi (192 bar)

ii) Pump delivery rate at minimum pressure: 33.3 GPM (126.1 l/min)

iii) Pump delivery rate at maximum

hydraulic power: 30.1 GPM (114.1 l/min)

Delivery pressure: 2410 psi (166 bar)

Power: 42.3 HP (31.6 kW)

## THREE POINT HITCH PERFORMANCE

|                                     |                |
|-------------------------------------|----------------|
| Observed Maximum Pressure psi.(bar) | 2785 (192)     |
| Location:                           | lift cylinder  |
| Hydraulic oil temperature: °F (°C)  | 150 (65)       |
| Location:                           | hydraulic sump |
| Category:                           | III            |
| Quick attach:                       | none           |

### SAE Static Test—System pressure 2510 psi (173 Bar) (4" lift cylinders)

|   |           |            |            |            |            |
|---|-----------|------------|------------|------------|------------|
| Hitch point distance to ground level in. (mm) | 8.0 (203) | 15.4 (390) | 23.2 (590) | 31.1 (790) | 35.7 (908) |
| Lift force on frame lb                        | 15940     | 14640      | 14930      | 14660      | 13130      |
| " " " " " (kN)                                | (70.9)    | (65.1)     | (66.4)     | (65.2)     | (58.4)     |

### ASAE Static Test—System pressure 2700 psi (186 Bar) (4" lift cylinders)

|   |           |            |            |            |            |
|---|-----------|------------|------------|------------|------------|
| Hitch point distance to ground level in. (mm) | 8.0 (203) | 15.4 (390) | 23.2 (590) | 31.1 (790) | 35.7 (908) |
| Lift force on frame lb                        | 17160     | 15760      | 16070      | 15780      | 14140      |
| " " " " " (kN)                                | (76.3)    | (70.1)     | (71.5)     | (70.2)     | (62.9)     |

## HITCH DIMENSIONS AS TESTED—NO LOAD

|   | OECD test |      | SAE test |      |
|---|-----------|------|----------|------|
|   | inch      | mm   | inch     | mm   |
| A | 30.0      | 763  | 28.0     | 711  |
| B | 15.0      | 380  | 15.0     | 380  |
| C | 17.4      | 443  | 17.4     | 443  |
| D | 15.6      | 395  | 15.6     | 395  |
| E | 7.9       | 200  | 7.9      | 200  |
| F | 12.4      | 315  | 12.4     | 315  |
| G | 35.6      | 905  | 35.6     | 905  |
| H | 2.4       | 62   | 2.4      | 62   |
| I | 19.9      | 505  | 19.9     | 505  |
| J | 23.2      | 590  | 23.2     | 590  |
| K | 18.3      | 465  | 18.3     | 465  |
| L | 48.8      | 1240 | 48.8     | 1240 |
| M | 25.6      | 650  | 25.6     | 650  |
| N | 36.0      | 915  | 36.0     | 915  |
| O | 9.1       | 230  | 8.0      | 203  |
| P | 50.2      | 1275 | 45.3     | 1150 |
| Q | 39.0      | 992  | 38.4     | 975  |
| R | 34.6      | 880  | 34.9     | 887  |

