

# Evaluation Report 168



## Bergen 40 Grain Auger

A Co-operative Program Between



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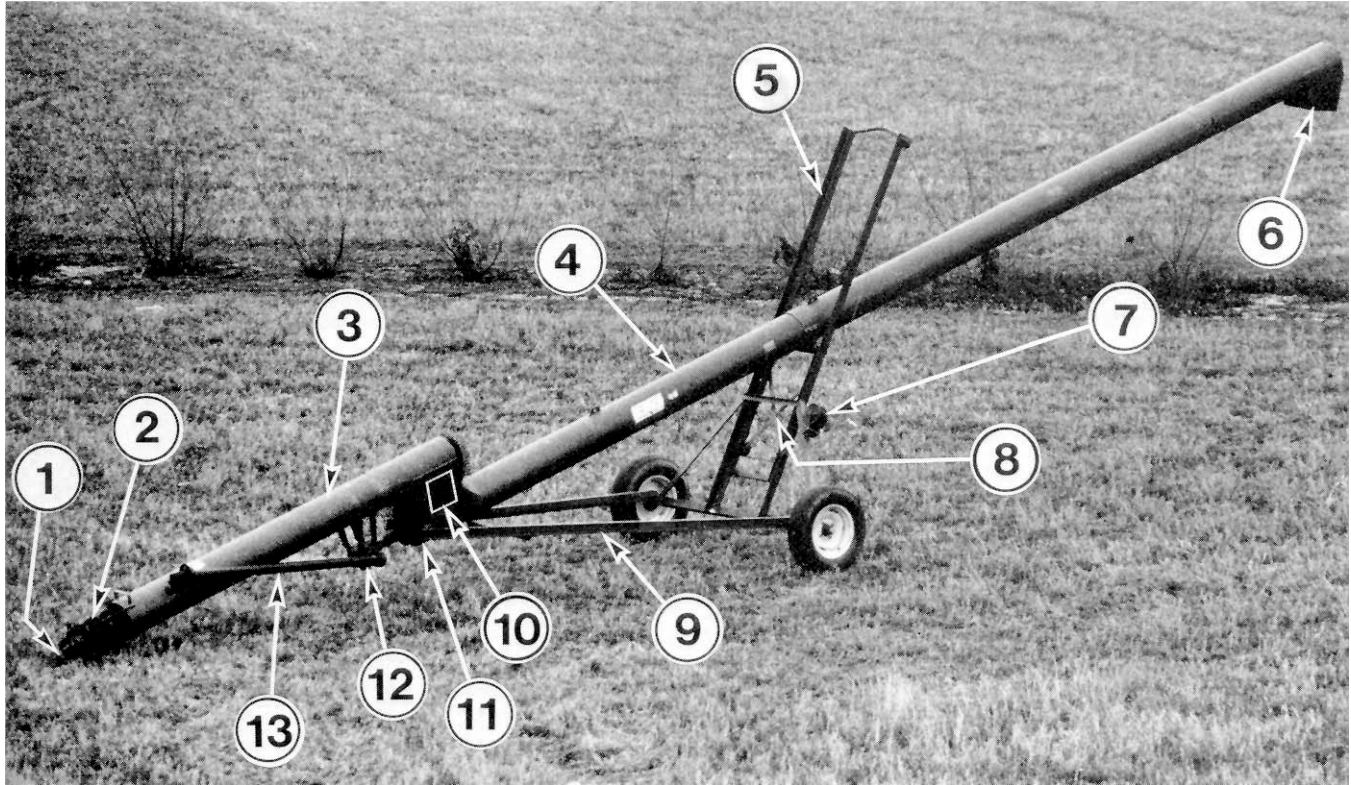
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

# BERGEN 40 GRAIN AUGER

## MANUFACTURER AND DISTRIBUTOR

Bergen Manufacturing Limited  
 P.O. Box 1331  
 Drake, Saskatchewan  
 S0K 1H0

**RETAIL PRICE:** \$3,860.00 (f.o.b. Drake, Saskatchewan), 50 foot length. Note: Auger in 40 foot length no longer available.



**FIGURE 1.** Bergen 40 Grain Auger: (1) Tow Hitch, (2) Inlet, (3) First Stage Auger Tube, (4) Second Stage Auger Tube, (5) Elevating Track, (6) Discharge Spout, (7) Cable Winch, (8) Elevating Carriage, (9) Lower Arms, (10) Service Panel, (11) Cleanout Panel, (12) Gear Box, (13) Power take-off Drive Line.

### SUMMARY AND CONCLUSIONS

At a 30° elevation angle, corresponding to a discharge height of 5.4 m (17.7 ft) and at the manufacturer's recommended flighting speed of 300 rpm, capacity of the Bergen 40 was 86.8 t/h (3180 bu/h) in wheat, 74.4 t/h (5120 bu/h) in oats, 85.0 t/h (3340 bu/h) in corn and 71.8 t/h (3160 bu/h) in rapeseed. Maximum capacities were obtained at flighting speeds between 375 and 475 rpm.

The power requirements ranged from 3.5 to 20 kW (4 to 25 hp) in dry grain. Capacity and power depended on flighting speed, elevation angle, grain type and moisture content. A 20 kW (25 hp) power supply should have ample reserve to operate the Bergen in most conditions.

Grain damage in dry wheat was less than 0.2% for each pass through the auger.

Considerable effort was needed to maneuver the Bergen due to the heavy hitch weight.

The Bergen 40 had several potential safety hazards. The auger elevating mechanism did not operate smoothly due to spreading of the track members and jamming of the elevating carriage. As well, no guard was provided over the intake flighting, and the hand winch did not meet current standards.

No durability problems occurred during the test.

No operator manual was provided.

### RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to eliminate spreading of the elevating tracks and to reduce the possibility of winch freewheeling.

2. Providing an auger inlet guard which conforms to current safety recommendations.
3. Lengthening the raising cable to provide sufficient winch drum wrap in the fully lowered position to comply with current safety standards.
4. Providing a caution decal on the drive line advising on alignment practices and permissible extensions of the power take-off shaft and safety decals which comply with current safety recommendations.
5. Providing an operator manual.

Chief Engineer -- E. O. Nyborg

Senior Engineer -- J. C. Thauberger

Project Engineer -- Carl W. Bolton

### THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We now have a completely new undercarriage and are using a K2500 Fulton winch without a ratchet.
2. A safety grate has always been supplied as standard equipment.
3. The cable has been lengthened.
4. We now use a Hayes-Dana power take-off driveline with lock features. A caution decal will be provided.
5. Assembly instructions now completed will be included in an operator manual.

**Note:** This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

## GENERAL DESCRIPTION

The Bergen 40 grain auger (FIGURE 1) is a 270 mm (10.7 in) diameter, two stage, portable screw conveyor, 12.1 m (40 ft) long. The auger tube is mounted on a frame supported by a single axle with two wheels. The first 455 mm (18 in) of the auger has double fighting. The remainder of the first stage and the second stage has single fighting.

Removable clean-out panels are located at the bottom of the second stage to allow cleaning when changing grains.

A hand-operated cable winch is used to adjust the auger angle which varies the discharge height. Bearings at the intake and outlet ends support the auger fighting. The Bergen 40 is driven directly by a 540 rpm tractor power take-off. Power is transmitted through a gear box and two roller chain drives to the fighting shafts.

Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The Bergen was operated for about ten hours while conveying dry wheat, oats, corn and rapeseed. It was also operated in a standard test material (APPENDIX II) for about one hour. As well, it was transported over gravel and paved highways for a distance of 60 km (40 miles). It was evaluated for ease of operation and adjustment, rate of work, power requirements, quality of work, operator safety and suitability of the operator manual.

## RESULTS AND DISCUSSION

### EASE OF OPERATION AND ADJUSTMENT

**Discharge Height:** The discharge height could be varied from 2.3 to 5.4 m (7.4 to 17.7 ft) with the hand operated cable winch. Corresponding elevation angles ranged from 14° to 30°.

With the auger empty, and the lift mechanism well lubricated, it took a maximum winch handle force of 90N (18 lb). Raising the auger to maximum height posed a potential hazard since the carriage shifted to the side of one track and separated from the other track (FIGURE 2). As a precaution, the track was modified to prevent this separation.

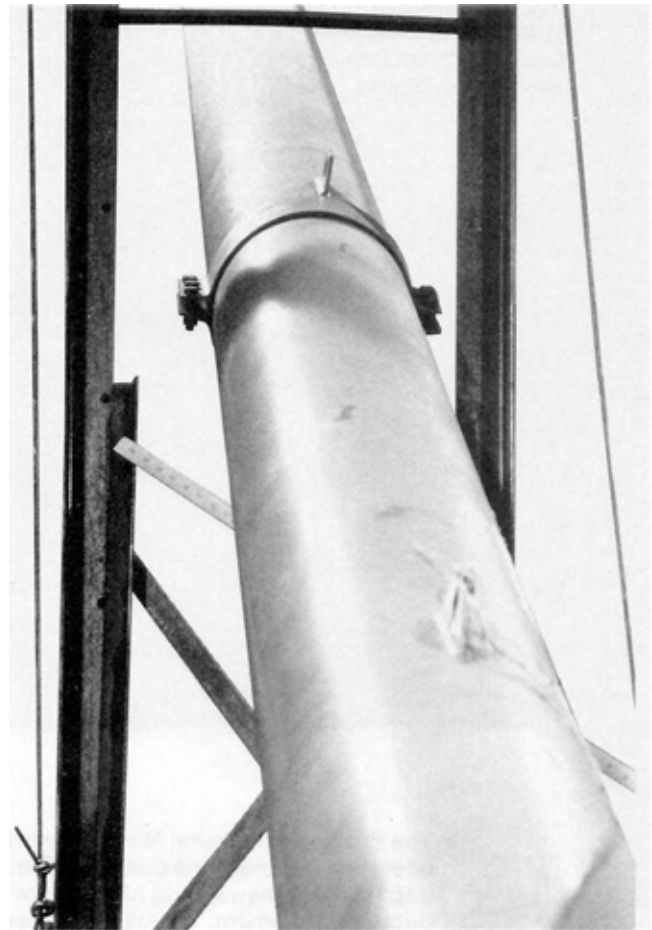


FIGURE 2. Carriage Separated from Track at Maximum Elevation.

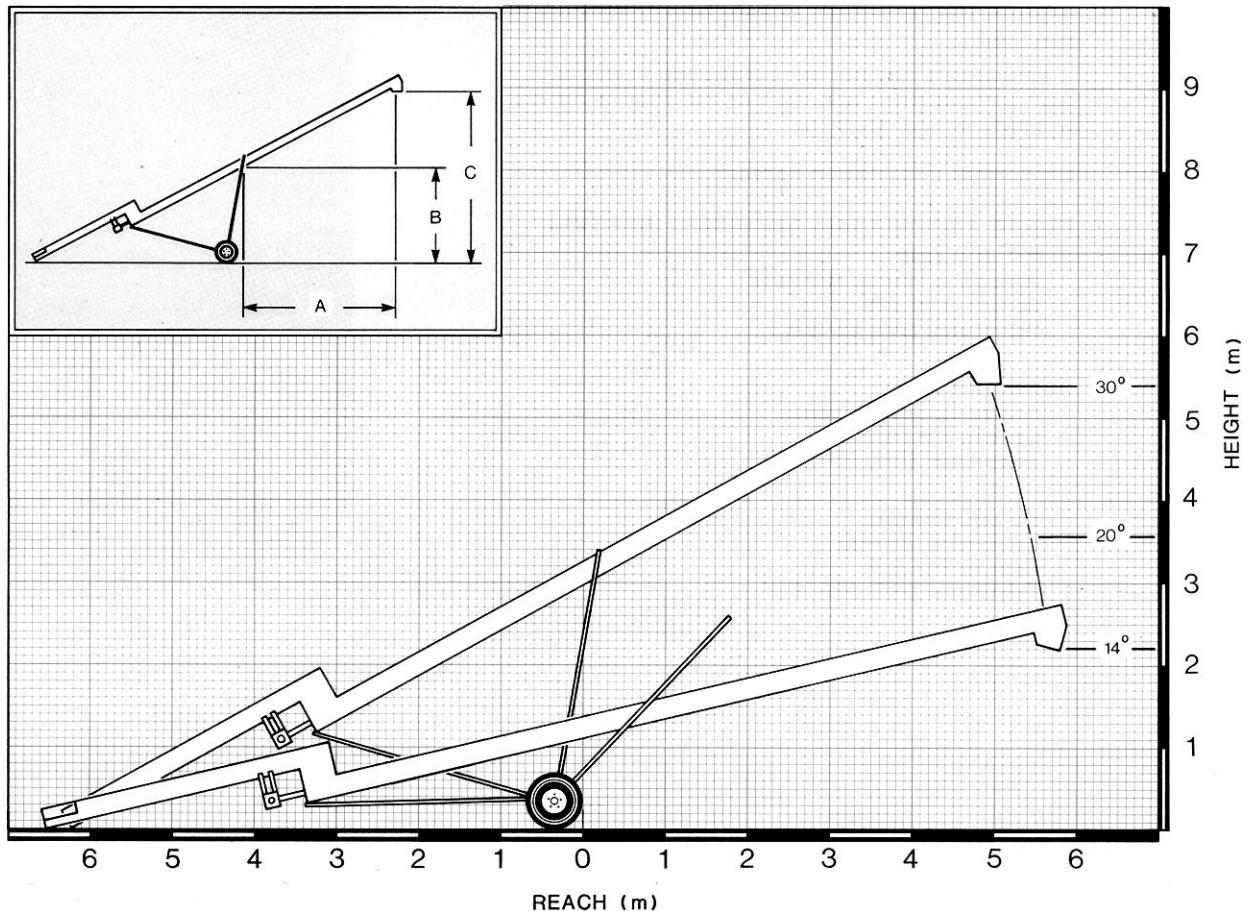


FIGURE 3. Reach and Clearance at Various Heights: (A) Reach, (B) Bin Eave Clearance, (C) Discharge Height.

When lowering, the elevating carriage sometimes momentarily jammed in the track causing hesitation and shock loading as the cable slack was abruptly taken up. Continuous winch handle control was needed when lowering to prevent the winch from freewheeling due to the design of the locking device. It is recommended that the manufacturer consider modifications to eliminate track binding and separation and also to reduce the possibility of winch freewheeling.

It took about 160 turns of the winch crank to fully raise or lower the auger. The winch was conveniently located at all discharge heights.

**Auger Reach:** The bin eave clearance and horizontal reach of the Bergen 40 are shown in FIGURE 3. Bin eave clearance, measured from the ground to the foremost part of the undercarriage, varied from 1.1 m (3.7 ft) at 14° to 2.9 m (9.6 ft) at 30° elevation. The reach, measured from the foremost part of the undercarriage to the centre of the discharge varied from 5.3 m (17.3 ft) at 14° to 4.8 m (15.7 ft) at 30° elevation.

Hitch weight varied from 37 kg (80 lb) at minimum elevation, to 61 kg (135 lb) at maximum elevation.

**Adjustments:** There are two roller chain drives between the first and second stage flightings which are easily adjusted. No other adjustments are needed.

**Transporting:** The Bergen transported well and was stable at speeds up to 100 km/h (60 mph) on paved highways, and 55 km/h (35 mph) on gravel roads. The hitch, on the inlet end, provided a reliable coupling to the tow vehicle. The operator should use a suitable hitch pin and safety chain to prevent accidental unhitching when transporting on public roads.

Clearance under power lines was adequate. The transport height was about 2.7 m (9 ft), when the auger was fully lowered.

When lowered to transport position, the winch drum had less than three complete wraps of cable which did not comply with current standards<sup>1</sup>. It is recommended that the cable be lengthened to provide sufficient contact with the drum.

#### RATE OF WORK

**Capacity:** FIGURE 4 shows the capacities of the Bergen 40 in dry wheat, oats, corn and rapeseed at a 30° elevation angle. Maximum capacities were 108, 94.4, 102 and 100 t/h (3960, 6490, 4010 and 4400 bu/h) in wheat, oats, corn and rapeseed respectively. Lower capacities can be expected in tough or damp grains. Maximum capacities were obtained at flighting speeds ranging from 375 to 475 rpm, well above the manufacturer's recommended speed of 300 rpm.

**Specific Capacity:** The specific capacity, per metre of vertical lift, is a method of determining the efficiency of a grain auger. A low specific capacity indicates inefficient power use, while a high specific capacity indicates efficient operation. Specific capacities vary, depending on the grain type. In general, when the flighting speed is increased, the capacity increases at a lower rate than the increase in power requirements, leading to an overall decrease in specific capacity.

As is shown in FIGURE 4, the specific capacity<sup>2</sup> ranged from 0.95 to 2.27 t/kW-h per metre of vertical lift when operating at a 30° elevation angle in dry wheat, oats, corn and rapeseed.

**Critical Speeds:** At certain critical flighting speeds, auger vibration becomes excessive. This phenomenon, known as resonance, is common to all augers and depends on grain type and operating conditions. Care should be taken not to operate at or near critical speeds.

#### POWER REQUIREMENTS

FIGURE 4 gives the power requirements for the Bergen 40 in dry wheat, oats, corn and rapeseed at a 30° elevation angle. Power requirements ranged from 3.3 to 20.0 kW (4 to 25 hp). More power would be needed in high moisture grains. In general, a 20 kW (25 hp) power unit would have ample reserve power to operate the Bergen in most conditions.

<sup>1</sup>American Society of Agricultural Engineers Tentative Standard: ASAE S 361. IT "Safety for Agricultural Auger Conveying Equipment", December 1979.

<sup>2</sup>Since the specific capacity is greatly dependent upon grain properties such as variety and moisture content, FIGURE 4 should not be used for comparing efficiencies of different augers. The data presented in FIGURE 7, APPENDIX II, using a standard medium may be used for comparisons of different augers.

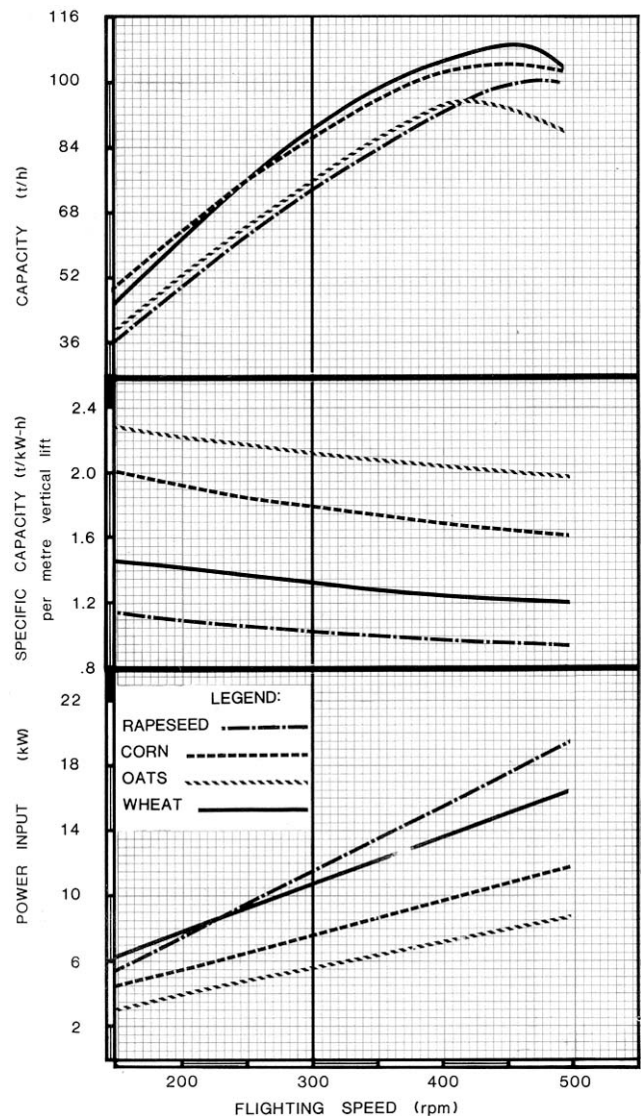


FIGURE 4. Capacity, Specific Capacity and Power Requirements for various Flighting Speeds at a 30° Elevation Angle.

#### QUALITY OF WORK

**Grain Damage:** Damage to dry wheat was less than 0.2% for each pass through the auger. This was insignificant as long as the same grain was not augered many times. Crackage would be lower with grain of higher moisture content.

#### OPERATOR SAFETY

Good shielding was provided around the PTO driveline and around the roller chain drives. The gearbox outlet shaft (FIGURE 5) was not shielded.

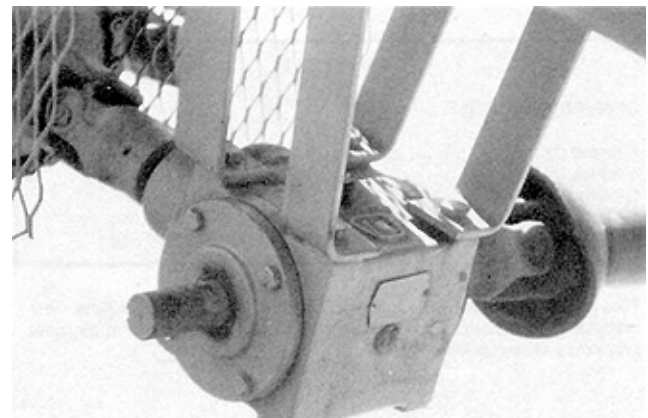


FIGURE 5. Unshielded Shaft

The power take-off driveline could separate if the tractor was placed too far away from the auger. It is recommended that a caution decal be placed on the driveline advising on alignment practices and permissible driveline extension.

The inlet was not provided with a guard meeting current standards (FIGURE 6). It is recommended that a guard be provided to conform with current safety recommendations.

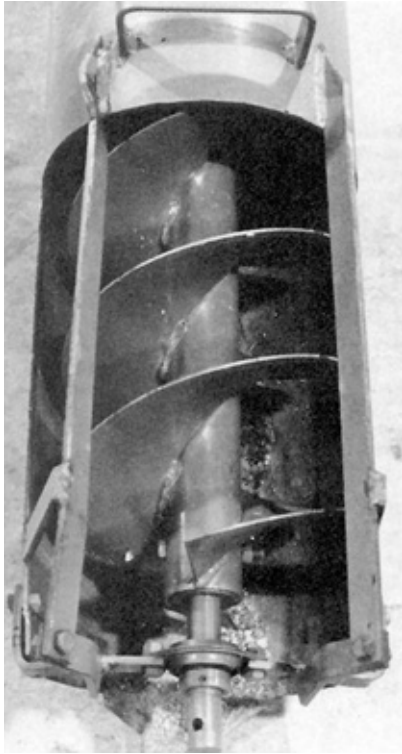


FIGURE 6. Auger Inlet

Although several safety decals were provided, these did not comply with current standards<sup>3</sup>. Warning signs were not provided in several hazard areas. It is recommended that safety decals be provided to comply with current safety regulations.

**OPERATOR MANUAL**

No operator manual was provided. It is recommended that the manufacturer supply a manual outlining operating, maintenance and safety procedures.

**DURABILITY RESULTS**

The Bergen was operated for about 10 hours. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. No mechanical problems occurred during the test.

<sup>3</sup>American Society of Agricultural Engineers Standard: ASAE S318.6, "Safety for Agricultural Equipment", March 1978.

| <b>APPENDIX I</b>                              |                           |                          |
|--|---------------------------|--------------------------|
| <b>SPECIFICATIONS</b>                          |                           |                          |
| <b>Serial Number:</b>                          | 4010076                   |                          |
| <b>Make:</b>                                   | Bergen                    |                          |
| <b>Model:</b>                                  | 40                        |                          |
| <b>Dimensions:</b>                             |                           |                          |
| -- length                                      | 12,120 mm                 |                          |
| -- width                                       | 2180 mm                   |                          |
| <b>Auger Tube:</b>                             |                           |                          |
| -- inside diameter                             | 267 mm                    |                          |
| -- inlet length                                | 405 mm                    |                          |
| -- material thickness                          | 4.0 mm                    |                          |
| -- outlet size                                 | square 280 mm x 280 mm    |                          |
| <b>Flighting:</b>                              |                           |                          |
| -- diameter                                    | 235 mm                    |                          |
| -- pitch                                       |                           |                          |
| -- exposed                                     | (double flighting) 235 mm |                          |
| -- covered                                     | 235 mm                    |                          |
| -- material thickness                          | 3.0 mm                    |                          |
| -- exposed length                              | 370 mm                    |                          |
| -- core diameter                               | 62 mm                     |                          |
| <b>Elevating Height:</b>                       |                           |                          |
| -- maximum (30°)                               | 5380 mm                   |                          |
| -- minimum (14°)                               | 2260 mm                   |                          |
| <b>Lubrication:</b>                            | <i>number</i>             |                          |
| -- pressure grease fittings                    | 5                         |                          |
| -- sealed bearings                             | 4                         |                          |
| -- wheel bearings (packed)                     | 2                         |                          |
| <b>Drive:</b>                                  |                           |                          |
| -- 540 rpm tractor power take-off              |                           |                          |
| -- power take-off flighting speed ratio        | 1:1                       |                          |
| -- auxiliary drive                             |                           |                          |
| -- roller chains                               | 2 (60-43P)                |                          |
| -- gear boxes                                  | 1                         |                          |
| <b>Winch:</b>                                  |                           |                          |
| -- make and model                              | Fulton 594                |                          |
| <b>Bin eave clearance @ maximum elevation:</b> | 2900 mm                   |                          |
| <b>Reach at maximum elevation:</b>             | 4750 mm                   |                          |
| <b>Tires:</b>                                  |                           |                          |
| -- size  | F78-14, 2 ply.            |                          |
| -- tread width                                 | 1980                      |                          |
| <b>Inlet Safety Shield:</b>                    |                           |                          |
| -- type of grill                               | open flat bars            |                          |
| -- material dimensions                         | 6 mm x 24 mm              |                          |
| -- grill openings                              | 165 mm x 400 mm           |                          |
| -- maximum open area                           | 660 cm <sup>2</sup>       |                          |
| -- maximum open dimension                      | 400 mm                    |                          |
| <b>Weight:</b>                                 | <u>Maximum Elevation</u>  | <u>Minimum Elevation</u> |
| -- right wheel                                 | 345 kg                    | 355 kg                   |
| -- left wheel                                  | 315 kg                    | 330 kg                   |
| -- hitch point                                 | 60 kg                     | 35 kg                    |
| Total  | 720 kg                    | 720 kg                   |
| <b>Optional Equipment:</b>                     |                           |                          |
| -- hydraulic winch                             |                           |                          |

## APPENDIX II

### PERFORMANCE WITH STANDARD TEST MATERIAL<sup>4</sup>

(a) Capacity and Power Requirements. FIGURE 7 gives the capacity, specific capacity and power requirements for the Bergen 40 in a standard test material. These data may be used for comparisons of different grain augers.

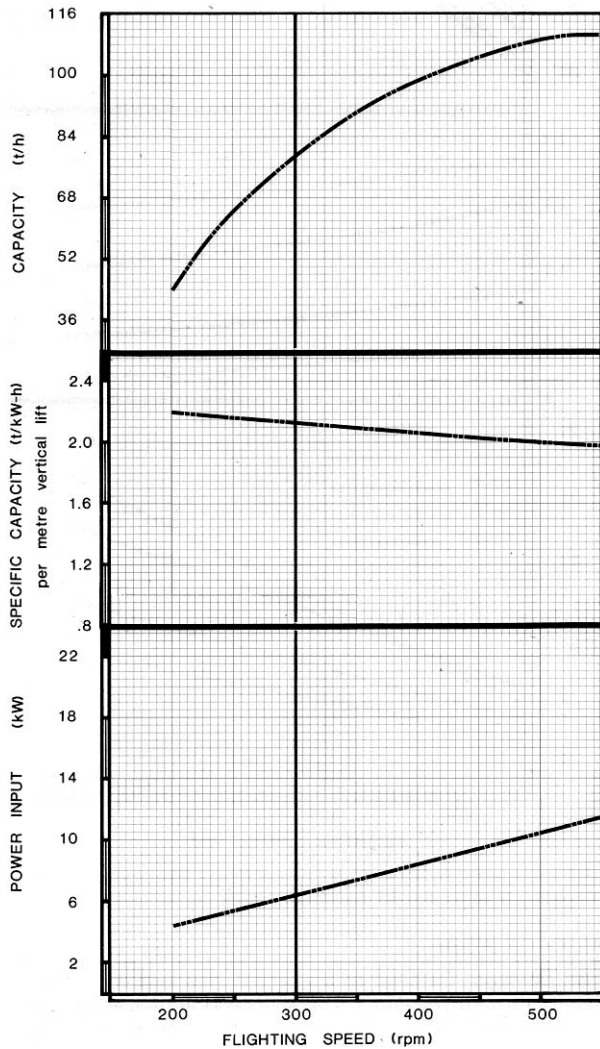


FIGURE 7. Capacity, Specific Capacity and Input Power with a Standard Test Material at a 30° Elevation Angle.

(b) Inlet Guard Flow Index. Since the Bergen had no inlet guard, no index could be determined.

## APPENDIX III

### CONVERSION TABLE

|                 |                         |
|-----------------|-------------------------|
| 1 tonne (t)     | = 2200 pounds mass (lb) |
| 1 metre (m)     | = 3.3 feet (ft)         |
| 1 kilowatt (kW) | = 1.3 horsepower (hp)   |
| 1 kilogram (kg) | = 2.2 pounds mass (lb)  |
| 1 newton (N)    | = 0.2 pounds force (lb) |

<sup>4</sup>The standard test material is a high density granular polyethylene. This material is consistent and not subject to damage or changes in physical properties as are grains.



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