

Evaluation Report

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Rock-O-Matic 546 Rock Picker

A Co-operative Program Between



ROCK-O-MATIC 546 ROCK PICKER

MANUFACTURER AND DISTRIBUTOR:

Rock-O-Matic Industries Ltd.
 Box 70
 Vonda, Saskatchewan
 S0K 4N0

RETAIL PRICE:

\$6,029.00 (July, 1981, f.o.b. Humboldt, complete with 540 rpm power take-off reel drive and optional reel shock absorbers and ductile grate.)



FIGURE 1. Rock-O-Matic 546.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Rock-O-Matic 546 rock picker was good in small rocks and poor in rocks larger than 380 mm (15 in). Ease of operation and adjustment were good.

Typical field speeds were from 2 to 8 km/h (1 to 5.0 mph) in scattered rocks and from 1 to 3.5 km/h (0.5 to 2.5 mph) in windrowed rocks. Ground speed was usually limited by the rock build-up on the grate. The Rock-O-Matic 546 could pick rocks from 50 to 575 mm (2 to 22 in) in size. In rocks larger than 380 mm (15 in) the workrate was reduced by rocks frequently jamming between the reel and the grate.

The amount of soil and trash delivered to the hopper depended on operating depth, reel speed and field conditions. In most conditions, soil retention was small.

Hopper capacity was about 2025 kg (4460 lb). The hopper dumping height of 1340 mm (53 in) was adequate for piling rocks.

A tractor with 45 kW (60 hp) maximum power take-off rating had sufficient power reserve to operate the Rock-O-Matic 546 in most field conditions. The Rock-O-Matic 546 transported well at speeds up to 40 km/h (25 mph).

The operator manual contained a parts list, assembly instructions and a brief list of safety precautions and service information.

The Rock-O-Matic 546 was safe to operate in rocks smaller than 380 mm (15 in). A safety hazard was encountered when removing rocks larger than 380 mm (15 in) that had jammed between the reel bat and the grate. A slow moving vehicle sign was not supplied.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to the power take-off reel drive to increase reel speed.

2. Modifications to reduce rock jamming between the reel bats and grate.
 3. Providing a more accessible transport lock.
 4. Expanding the operator manual to include information on operation and adjustment.
 5. Supplying a slow moving vehicle sign.
 6. Modifications to protect the hydraulic cylinder fittings from rock damage.
- Chief Engineer -- E.O. Nyborg
 Senior Engineer -- G.E. Frehlich
 Project Technologist -- D.H. Kelly

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The reel speed has been increased on the new machines.
2. Modifications to reduce rock jamming are being considered.
3. The transport lock will not be changed in the immediate future.
4. The operator manual is continuously being updated and improved.
5. This is being considered.
6. The hydraulic cylinder fittings will be protected on future machines.

MANUFACTURER'S ADDITIONAL COMMENTS

1. The reel shaft failed after one hour of operation because it was made of lower grade steel than was specified to our supplier.
2. The reel cam wheel hub is now being made from ductile steel, which has significantly reduced hub failures.

Optional Equipment:
 -reel shock absorbers
 -ductile grate

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

GENERAL DESCRIPTION

The Rock-O-Matic 546 is a pull-type rock picker with a 1.6 m (63 in) wide grate. As standard equipment, it is supplied with a 540 rpm power take-off driven reel, while an optional hydraulic reel drive is available.

The Rock-O-Matic 546 is designed for picking rocks from the soil surface. An inclined, adjustable finger grate, consisting of 17 steel bars spaced at 48 mm (1.9 in) operates just beneath the soil surface. Rocks are assisted onto the grate and conveyed along it into a hopper, by a cam-action reel. The reel has three spring loaded bats, each with 18 teeth. The hopper holds about 2025 kg (4460 lb) of rocks. Grate height and hopper dumping are hydraulically controlled.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Rock-O-Matic 546 was operated in the conditions shown in TABLE 1 for 104 hours. It was evaluated for rate of work, quality of work, ease of operation and adjustment, power requirements, safety and suitability of the operator manual.

TABLE 1. Operating Conditions

Rock Size	Hours
Less than 200 mm (8 in)	77
200 to 300 mm (8 to 12 in)	20
Greater than 300 mm (12 in)	7
Total	104
Rock Concentration	Hours
Light	27
Medium	72
Heavy	5
Total	104

RESULTS AND DISCUSSION

RATE OF WORK

Suitable field speeds ranged from 2 to 8 km/h (1 to 5 mph) in scattered rocks and from 1.0 to 3.5 km/h (0.5 to 2.5 mph) in windrowed rocks. Maximum speed was determined by operator skill, rock size, rock concentration and field conditions. In heavy rock concentrations, rock build-up on the grate limited ground speed to 3 km/h (2 mph). Ground speed was further reduced in rocks over 380 mm (15 in) in size, since the reel frequently jammed.

QUALITY OF WORK

Picking Characteristics: Rubber covered wheels running on a metal cam track guided the reel bats in a linear path over the straight section of the grate. Each reel bat was held against the cam track by a spring, which allowed the reel bat to retract up to 380 mm (15 in) to clear obstructions. An adjustable slip clutch was provided on the reel drive sprocket.

Reel aggressiveness was fair. If too many rocks were fed onto the grate, the reel bats retracted causing rock build-up on the grate. In heavy concentrations of small rocks (FIGURE 2), two passes were usually needed to remove most of the rocks. In large rocks (FIGURE 3), one pass was usually sufficient.

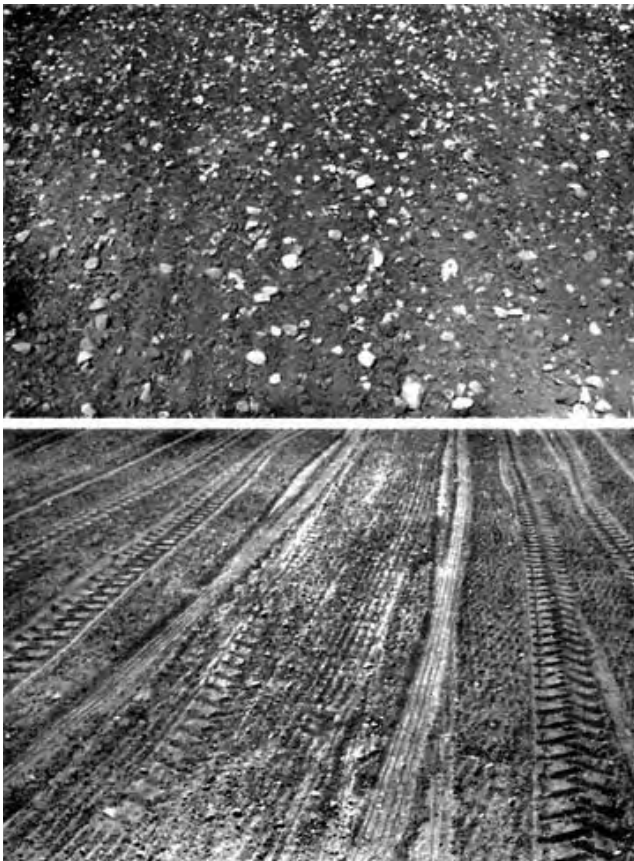


FIGURE 2. Performance in small rocks: (Top: Before picking; Bottom: After two passes with picker).

The angle between the bat teeth and the grate, combined with the bat motion, frequently caused rocks to wedge between the bats and the grate. If the wedged rock was smaller than 380 mm (15 in), the bat would retract over the rock and spring back into position on the cam track. If the rock was larger than 380 mm (15 in), the fully retracted bat would jam against the rock and stop the reel (FIGURE 4). A tractor and chain were used to pull out occasional jammed rocks since the power take-off drive prevented the reel from being reversed. Modifications to reduce rock jamming are recommended.

The 1.6 m (63 in) wide grate was wide enough to accept most rock windrows. In non-windrowed areas of concentrated rock, a wider grate would be desirable.

Reel Speed: Proper reel speed was necessary to fully utilize hopper capacity and to obtain maximum workrate. The 34 rpm reel speed, corresponding to a power take-off speed of 540 rpm, was too slow to completely fill the hopper. The slow reel speed also

limited ground speed due to rock build-up on the grate. Increasing the reel speed to 43 rpm filled the hopper to capacity and increased the workrate without throwing rocks over the back of the hopper. It is recommended that the manufacturer consider modifications to increase the reel speed to about 45 rpm.



FIGURE 3. Performance in large rocks: (Top: Before picking; Bottom: After one pass with picker).



FIGURE 4. Typical rock jam.

To effectively remove surface rocks and to minimize soil retention in the hopper, forward speed had to be selected to suit field conditions. In scattered rocks, best performance was achieved with a tooth index¹ of about 1.3 in fields with light rock concentrations, 3.5 in fields with medium rock concentrations and 5.2 in fields with heavy rock concentrations. In windrowed rocks, best performance was achieved with a tooth index of about 3 in fields with light rock concentrations, 6.5 in fields with medium rock concentrations and 10.3 in fields with heavy rock concentrations. Operating at the recommended reel speed of 43 rpm, corresponding ground speeds

¹The tooth index is the ratio of the tangential tooth tip speed to the forward speed. A high tooth index gives aggressive picking action.

were about 8, 2.9, 1.8 km/h (4.9, 1.8 and 1.1 mph) in scattered rocks for light, medium and heavy rock concentrations, respectively. For windrowed rocks, ground speeds were about 3.5, 1.5 and 1.0 km/h (2.2, 0.9 and 0.6 mph) for light, medium and heavy rock concentrations respectively.

Operating Depth: It was usually best to operate with the grate just touching the soil surface. This was adequate for removing rocks lying on the surface, however, partially buried rocks were pushed back into the soil by the grate. The grate could be set below the soil surface to remove small embedded rocks, if the field was not too firm. Caution was needed to prevent damage to the grate and frame when working in fields containing large embedded rocks.

Trash and Soil Retention: The amount of soil and trash placed in the hopper depended on machine operation and field preparation. The amount of soil retained was small in most field conditions. Operating the rock picker with the grate set too low, the reel speed too fast or in fields containing dirt lumps or trash increased the amount of soil and trash retained. Property formed, clean windrows were necessary to minimize soil retention when picking fields windrowed with a rock rake.

Field Preparation: Best performance was in fields with a firm base and minimum amount of trash or dirt lumps. It is often desirable to use a rod weeder before picking to place the rocks on the surface, and to firm the soil.

The use of a rock rake is recommended when working fields with an abundance of rocks smaller than 300 mm (12 in). The rock rake brings most rocks to the surface and reduces picking time.

Stability: The Rock-O-Matic 546 was very stable. Skewing occurred only when the grate hooked large subsurface rocks. When this occurred, the grate either jumped over the rock or the picker skewed to the left until the grate cleared the rock.

Rock Size: The Rock-O-Matic 546 could effectively remove rocks ranging in size from 50 mm (2 in) to 575 mm (22 in). Rocks smaller than 50 mm (2 in) fell through the grate and remained in the field. Rocks larger than 575 mm (22 in) would not pass between the reel centre shaft and the grate.

EASE OF OPERATION AND ADJUSTMENT

Reel Drive: The test machine was equipped with the standard power take-off reel drive. Reel speed was 34 rpm at 540 rpm power take-off speed, which was too slow for optimum rock picker performance. Reel speed could be lowered by decreasing tractor engine speed. The slip clutch was easy to adjust. It effectively prevented driveline damage during the test.

Reel spring tension, bat force and clearance between the reel teeth and the grate were not adjustable.

The reel could not be reversed to clear rock blockages or build-up on the grate.

Hopper Dumping: The hopper held about 2025 kg (4460 lb) of large or small rocks (FIGURE 5) when using a reel speed of 43 rpm and filling the hopper completely. When operating at the standard 540 rpm power take-off speed, the reel speed was only 34 rpm and the hopper could be only partially filled (FIGURE 6).

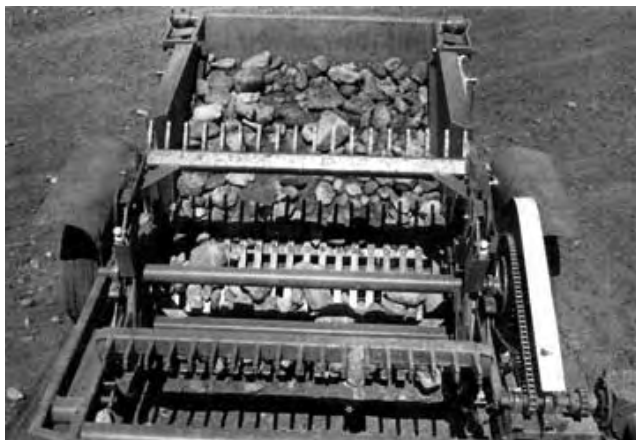


FIGURE 5. Hopper Capacity at 43 rpm Reel Speed.

One pair of tractor remote hydraulic outlets controlled the grate height and raised the hopper for dumping. To dump the hopper, the

grate is lowered to the ground until the hopper begins to rise. The hopper emptied completely and could pile rocks 1340 mm (53 in) high.



FIGURE 6. Hopper Capacity at the Standard 34 rpm Reel Speed.

Maneuverability: The Rock-O-Matic 546 was quite maneuverable. Its turning radius was short enough for easy operation, however, care had to be taken to prevent interference between the tractor tire and the power take-off shaft when making left turns.

Since it is desirable to feed rocks into the rock picker without driving over them, the distance between the hitch and the outside of the tractor rear wheels should not exceed 685 mm (27 in).

Transporting: The Rock-O-Matic 546 was easily transported. It towed well at speeds up to 40 km/h (25 mph). The 180 mm (7 in) transport clearance was adequate. One transport lock (FIGURE 7) prevented the grate from being lowered while transporting. The transport lock was located behind the left wheel and was difficult to reach. Modifications to provide a more accessible transport lock are recommended.



FIGURE 7. Transport Lock.

Hitching: The Rock-O-Matic 546 was easily hitched to a tractor. A hitch jack was provided and the hitch clevis was fixed allowing one-man hook-up. The hitch clevis was adjustable vertically to permit frame levelling. Proper draw pin fastening was important since negative hitch loads occurred when the hopper was fully loaded.

Ease of Servicing: Servicing was easy. All grease fittings and chains were to be lubricated daily, and were accessible.

POWER REQUIREMENTS

A tractor with 45 kW (60 hp) maximum power take-off rating had sufficient power reserve to operate the Rock-O-Matic 546 in most conditions. Average power requirements varied widely depending on field conditions. High draft forces occurred when the grate hooked partially buried rocks.

OPERATOR MANUAL

The operator manual contained a parts list, assembly instructions, a brief list of safety precautions and service information. It is recommended that the manufacturer expand the operator manual to include information on adjustments and operation.

OPERATOR SAFETY

The Rock-O-Matic 546 was safe to operate and service as long as common sense was used in following good safety procedures.

A serious safety hazard was encountered when rocks jammed between the reel bat and the grate, fully retracting the reel bat under spring pressure. Serious bodily harm could result if the bat suddenly released when the operator was removing the rock. Modifications to reduce the frequency of rock jams have been recommended.

The maximum load on each of the two 11L x 15, 6-ply tires was 2064 kg (4550 lb) with a full hopper. This exceeded the maximum load of 1122 kg (2470 lb) recommended by the Tire and Rim Association. Although the tires were overloaded, no failures occurred during the test.

No slow moving vehicle sign was supplied. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Rock-O-Matic 546 during 104 hours of field operation. The intent of the test was functional evaluation. The following mechanical problems are those, which occurred during the functional testing. An extended durability test was not conducted.

TABLE 2. Mechanical History

Item	Hours
Reel:	
-The reel bearing, slip clutch and reel shaft failed and were replaced at	1
-The reel cam wheel hub broke and was replaced at	7, 8, 26, 47, 97
Hydraulic Fittings:	
-Several hydraulic cylinder fittings were broken by flying rocks and replaced at	4, 23, 26, 97
Wheels:	
-The left wheel cast hub broke and was replaced at	8
Drive Line:	
-The power take-off shaft was bent by the tractor tire during a sharp left turn and was replaced at	66

DISCUSSION OF MECHANICAL PROBLEMS

Reel: The reel bearing, slip clutch and reel shaft failed when a large rock jammed between the reel and the grate. The reel bearing and slip clutch failures occurred when the reel shaft broke. No failures occurred after the reel shaft was replaced.

The cam wheel hubs broke when the reel bats snapped into position after retracting to clear a rock. Modifications to reduce the frequency of rock obstructions should reduce cam wheel failures.

Hydraulic Fittings: Rocks accumulated on the rock picker frame, causing damage to the fittings when the hydraulic cylinders were activated. Modifications to prevent rock accumulation on the frame are recommended.

Wheels: The left wheel hub broke when the grate hooked a partially buried rock causing the picker to skew with a fully loaded hopper.

APPENDIX I SPECIFICATIONS

MAKE:	Rock-O-Matic
MODEL:	546
SERIAL NUMBER:	OM5 15139
WEIGHT: (hopper empty)	
-- left wheel	912 kg
-- right wheel	936 kg
-- hitch	234 kg
TOTAL	2082 kg
TIRES:	2, 11L x 15, 6-ply.
OVERALL DIMENSIONS:	
-- width	2935 mm
-- height	1690 mm
-- length	4810 mm
-- ground clearance	180 mm
GRATE:	
-- width	1600 mm
-- number of grate bars	17
-- spacing between grate bars	48 mm
-- length of grate bars	760 mm
-- grate angle while operating	47 degrees
REEL:	
-- diameter	1276 mm
-- number of bat arms	3
-- number of teeth per bat	18
-- spacing between teeth	70 mm
-- tooth length	127 mm
-- reel speed at 540 rpm PTO speed	34 rpm
HOPPER:	
-- hopper dumping height	1340 mm
-- hopper capacity	2025 kg
NUMBER OF HYDRAULIC CYLINDERS:	4
NUMBER OF CHAIN DRIVES:	1
NUMBER OF LUBRICATION POINTS:	12
OPTIONAL EQUIPMENT:	
-- reel shock absorbers	
-- ductile grate	

APPENDIX II MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

- | | |
|--------------|-------------------|
| a) excellent | d) fair |
| b) very good | e) poor |
| c) good | f) unsatisfactory |

APPENDIX III CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)



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