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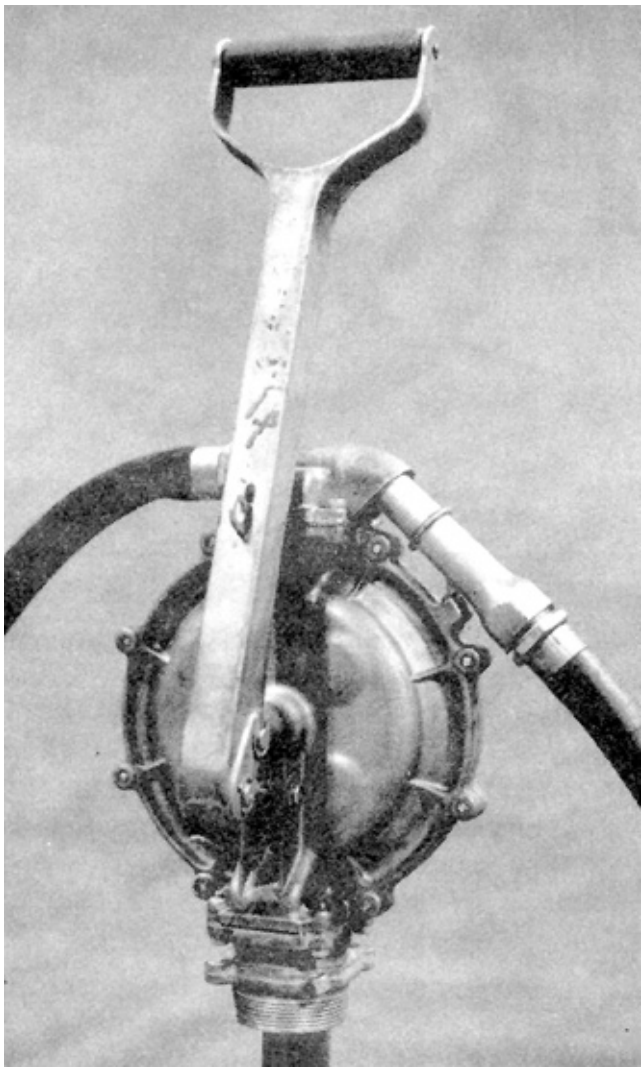
Evaluation Report 70



National 30A1 Diaphragm Hand Pump

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

NATIONAL 30A1 DIAPHRAGM HAND PUMP

MANUFACTURER:

National-Spencer, Inc.
424 Greenwood
Wichita, Kansas 67201
U.S.A.

DISTRIBUTOR:

Oliver Industrial Supply Ltd.
236 - 36th Street North
Lethbridge, Alberta
T1J 4B2

RETAIL PRICE:

$ 94.40 (February, 1979, f.o.b. Lethbridge)

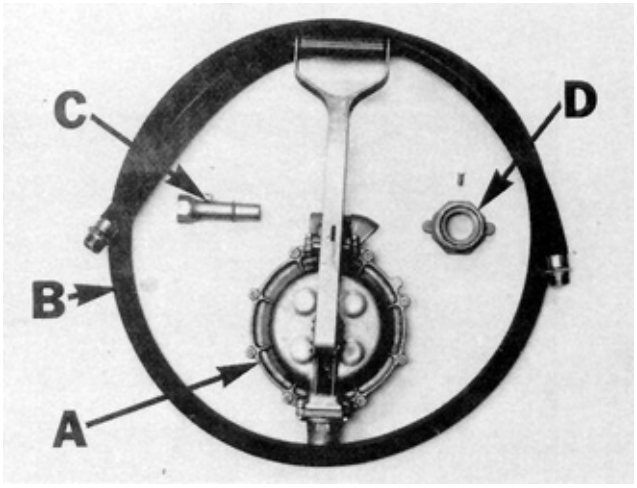


FIGURE 1. National 30A1 Hand Pump: (A) Pump Body, (B) Outlet Hose, (C) Outlet Nozzle, (D) Bung Adaptor.

SUMMARY AND CONCLUSIONS

Normal pumping rates for the National 30A1 hand pump were from 25 to 45 strokes per minute. The flowrate at an average pumping rate of 35 strokes per minute, at zero suction and discharge heads, was 36 L/min (7.9 gal/min). A maximum flowrate of 67 L/min (14.7 gal/min) was obtained at 66 strokes per minute but could only be maintained for about 30 seconds. Increasing the suction head to 0.9 m (3 ft) and the discharge head to 1.8 m (6 ft), at 35 strokes per minute, resulted in an 8% reduction in flowrate.

Pumping effort increased significantly with increased pumping rates, suction and discharge heads. The required pumping force at the end of the pump handle increased from 86 N (19 lb) at 25 strokes per minute to 201 N (45 lb) at 45 strokes per minute. Increasing the suction and discharge heads from zero to 0.9 m (3 ft) and 1.8 m (6 ft), respectively, increased pumping effort by 8%, when operating at 35 strokes per minute.

The National 30A1 was very portable. The pump was very easy to position in a fuel supply tank since it was equipped with a rotating bung adaptor.

The pump was equipped with a suction strainer that was easily serviced by removing the bottom cover on the pump body.

The National 30A1 was safe to operate. When filling a tank, care must be exercised to prevent overflow.

A well illustrated parts list and descriptive brochure were supplied with the pump.

A few mechanical problems occurred during the test. The pump, during operation, constantly leaked through the vent in the base of the pump. The outlet hose was soft and kinked at the ends when held up to high fuel tanks. The rubber reed-outlet valve split and was replaced. The pump body moved within the bung adaptor since the set screw was inadequate to firmly hold the pump.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to prevent fuel leaking through the vent in the base of the pump.
2. Modifications to avoid hose kinking.
3. Modifying the bung adaptor to avoid pump body movement within the adaptor.
4. Investigating the possibility of eliminating the need for a spring on top of the outlet valve.

Chief Engineer: E. O. Nyborg

Senior Engineer: E. H. Wiens

Project Technologist: ***L. B.*** *Storozynsky*

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Although thousands of these pumps have been sold throughout the United States, fuel leaking through the base vent has not been presented to us as a significant problem
2. The hose used on this pump is an inexpensive farm tank type hose and although it may occasionally kink, the alternative would be to go to a more expensive hose with a resulting higher cost for the pump.
3. The bung adaptor now has two set screws which appears to have corrected the problem.
4. On current production the spring has been eliminated from the top and bottom valves.

MANUFACTURER'S ADDITIONAL COMMENTS

We feel that we have further improved the pump by going to a formed steel handle and formed steel links. Both of these parts were previously die cast and there was occasionally some breakage.

GENERAL DESCRIPTION

The National 30A1 is a self priming, hand operated, double action diaphragm pump. It is designed for pumping gasoline, diesel fuel, solvents or lube oil from above ground tanks and drums equipped with 50 mm (nominal 2 inch NPT) openings. It is equipped with a 2.47 m (8 ft) outlet hose, a telescoping suction pipe and a 375 mm (14.75 in) pump handle. The top of the pump handle is equipped with a wooden grip and can be locked against the pump body to prevent theft. The pump nozzle when not in use is stored within a receptacle on the pump body.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The National 30A1 was evaluated for ease of operation and safety. Pump performance characteristics and pumping effort at various pumping rates, suction and discharge heads were determined with diesel fuel.

RESULTS AND DISCUSSION

PUMP PERFORMANCE

Pumping Rate: Pumping rates from 25 to 45 strokes per minute were determined as the normal range a farmer could continuously operate this pump when filling a large tractor tank. A maximum pumping rate of 66 strokes per minute was reached but was impossible to maintain for any reasonable length of time.

Flowrate: Pump performance characteristics with diesel fuel for two different suction and discharge heads are given in FIGURE 2. Suction head is the 'distance the fuel level is below the pump intake valves and discharge head is the height the outlet nozzle is held above the pump. Suction heads of 0 and 0.9 m (0 and 3 ft) correspond to full and empty levels of typical farm truck fuel storage tanks.

Increased pumping rates increased the flowrate by about 1 L (0.22 gal) per stroke. This was 19% greater than the manufacturer's rated flowrate of 0.84 L (0.18 gal) per stroke. Flowrate at the average pumping rate of 35 strokes per minute at zero suction and discharge heads was 36 L/min (7.9 gal/min).

Increasing suction and discharge heads had only a small effect on the flowrate. Increasing the suction and discharge heads from zero to 0.9 m (3 ft) and 1.8 m (6 ft), respectively, at 35 strokes per minute, decreased the flowrate from 36 L/min (7.9 gal/min) to 33 L/min (7.3 gal/min). This combination of suction and discharge heads is more severe than would be encountered in transferring fuel to most farm machinery and represents an 8% decrease in flowrate.

The maximum flowrate obtained was 67 L/min (14.7 gal/min) at a pumping rate of 66 strokes per minute. This pumping rate could only be maintained for about 30 seconds.

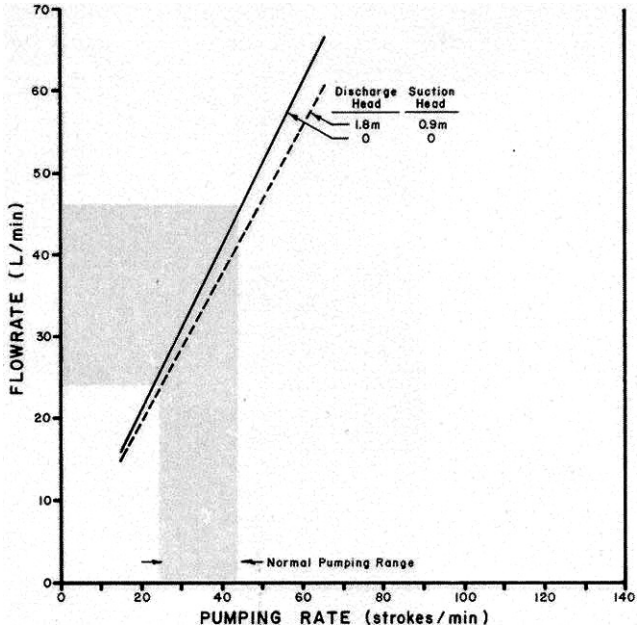


FIGURE 2. Flowrate with Diesel Fuel at Two Suction and Discharge Heads.

EASE OF OPERATION

Pumping Effort: Pumping effort is the hand force that has to be exerted, perpendicular to the pump handle, to operate the pump. FIGURE 3 shows the hand -.force needed at various pumping rates, suction and discharge heads. Pumping effort increased with increasing pumping rates and with increased head. At a pumping rate of 45 strokes per minute, with zero suction and discharge heads, pumping effort was 201 N (45 lb) compared to 88 N (19 lb) at 25 strokes per minute. At an average pumping rate of 35 strokes per minute, pumping effort increased from 144 N (32 lb) at zero suction and discharge heads to 156 N (35 lb) with suction and discharge heads of 0.9 m (3 ft) and 1.8 m (6 ft), respectively.

Fuel Tank Connection: The National 30A1 was portable and was equipped with a 50 mm (nominal 2 inch NPT) bung adaptor to fit standard fuel tank openings. The bung adaptor turned relative to the pump body, making it very easy to install and position in a fuel tank.

Filling A Fuel Tank: The outlet hose was equipped with a standard fuel nozzle. An automatic shut-off nozzle is available as optional eqipment. Pumping at 35 strokes per minute, it took from 6 to 7 minutes to fill a 225 L (50 gal) tractor fuel tank with filler opening typically located 1 m (3.3 ft) higher than the top of a typical farm truck fuel supply tank. The outlet hose was very soft and kinked frequently (FIGURE 4), restricting fuel flow, when filling tanks that were higher than the fuel supply tank. It is recommended that the manufacturer modify the hose to prevent kinking.

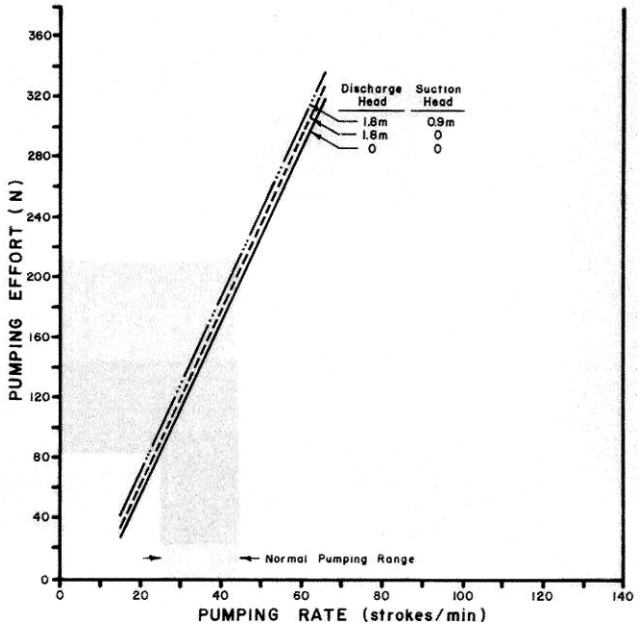


FIGURE 3. Pumping Effort with Diesel Fuel at Various Pumping Rates, Suction and Discharge Heads.

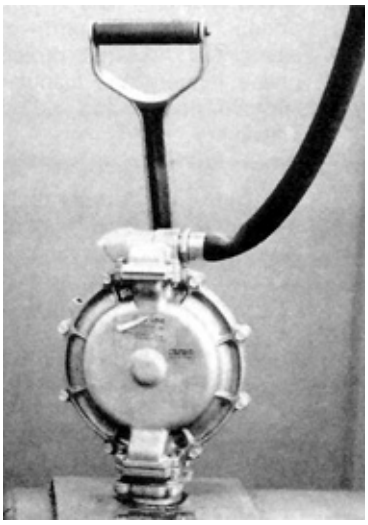


FIGURE 4. Kinked Outlet Hose.

Servicing: The National 30A1 was equipped with a suction fuel strainer. The wire strainer was located in the pump base just below the intake valves. It could be serviced by removing the base on the pump body.

The pump required no lubrication.

Valve Spring: The manufacturer's parts list and brochure indicated that the National 30A1 pump was equipped with a valve spring above the top reed valve (FIGURE 5) to prevent siphoning from the storage tank if the hose fell from its receptacle on the pump body. The pump tested was not equipped with a valve spring. However, tests done with a valve spring in the pump showed that the spring caused the flowrate to decrease by about 10% and the pumping effort to increase by about 25% when operating at 35 strokes per minute. It is recommended that the manufacturer investigate the possibility of eliminating the valve spring from the pump.

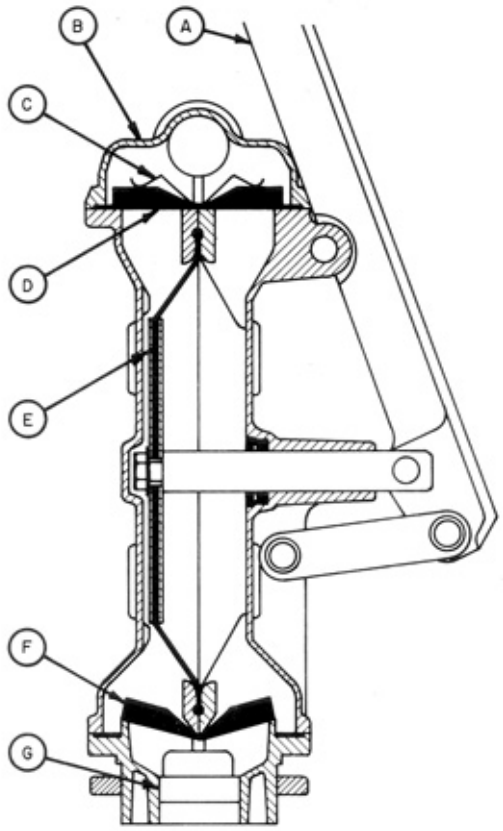


FIGURE 5. Schematic View of National 30A1 Hand Pump: (A) Pump Handle, (B) Upper Cover. (C) Valve Spring, (D) Outlet Reed Valve, (E) Diaphragm, (F) Inlet Reed Valve, (G) Bottom Cover.

SAFETY

The fuel outlet nozzle was equipped with a hook which prevented it from falling out of a filler opening when pumping. The hook also prevented the outlet nozzle from falling out of the pump body receptacle when the nozzle was not in use.

When filling a tank, care must be exercised to avoid overflow. To prevent overflow, an automatic shut-off nozzle is available as an option.

A lock arm was provided which permitted locking the pump handle in storage position.

OPERATOR'S MANUAL

A well illustrated parts list and a descriptive brochure were supplied with the pump.

MECHANICAL PROBLEMS

The National 30A1 was operated for about 3 hours. The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted.

A few mechanical problems were encountered during the functional evaluation. The pump, during operation, constantly leaked through the vent located in the pump base below the inlet valve. During the pressure stroke, the inlet valve did not close completely and fast enough, causing a portion of the fuel to leak back through the vent. It is recommended that the manufacturer make modifications to prevent fuel leaking through the vent.

The outlet valve split in the middle (FIGURE 6) and was replaced.

The pump body moved within the bung adaptor when pumping since the set screw was inadequate to firmly hold the pump. It is recommended that the manufacturer modify the bung adaptor to eliminate this movement.

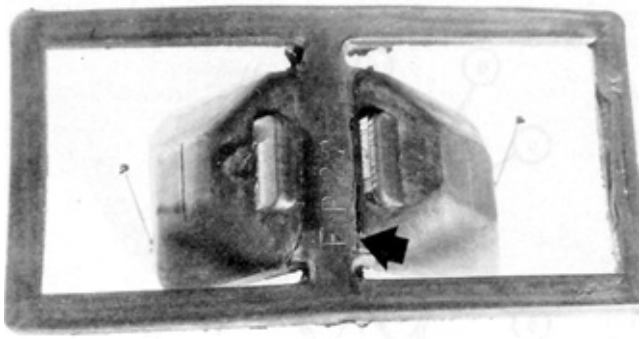


FIGURE 6. Split Outlet Valve.

APPENDIX I

SPECIFICATIONS

MAKE: National

MODEL: 30A1

OVERALL DIMENSIONS:	
- height	483 mm (19 in)
- width	206 mm (8.1 in)
- length	155 mm (6.1 in)
- pump handle length	375 mm (14.75 in)
TOTAL WEIGHT:	5.5 kg (12 lb)
SUCTION PIPE:	
- size	20 mm (nominal 0.75 inch NPT)
- telescoping length	559 to 991 mm (22 to 39 in)
- storage tank bung adaptor	50 mm (nominal 2 inch NPT)
DISCHARGE HOSE:	
- size	20 mm (0.75 in)
- length	2.47 m (8 ft)

APPENDIX II

METRIC UNITS

In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used:

1 litre per minute (L/min)	= 0.22 Imperial gallons per minute {gal/min)
1 metre (m) = 1000 millimetres (mm)	= 39.37 inches (in)
1 Newton (N)	= 0.22 pounds force (lb)
1 kilogram (kg)	= 2.20 pounds mass (lb)

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